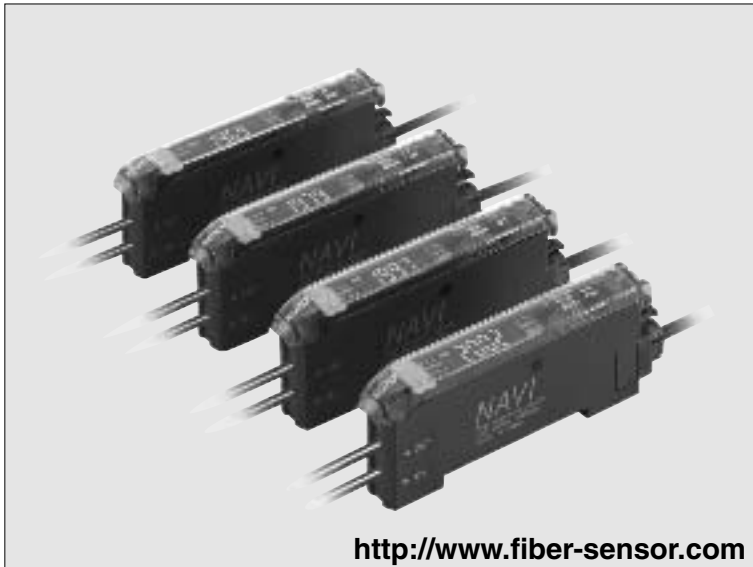


# FX-301 SERIES

## Digital Fiber Sensor



<http://www.fiber-sensor.com>

Superior performance and advanced user-friendly multi-functionality enables expert usage on the very first day

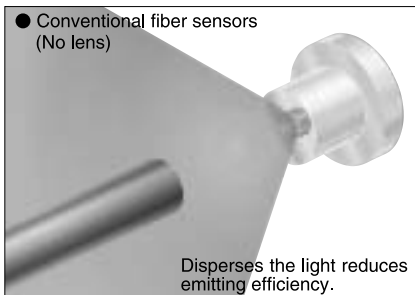
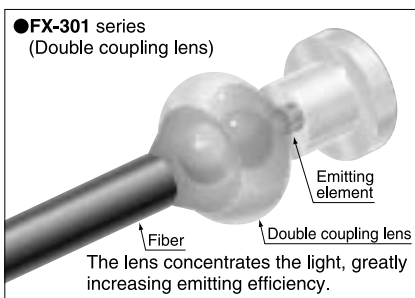
\* Passed the UL 991 Environment Test

\* UL 61010C-1 compatible, Passed the UL 991 Environment Test based on SEMI S2-0200.  
 [Category applicable for semiconductor manufacturing: TWW2, Process Equipment]  
 [Applicable standards: UL 61010C-1]  
 [Additional test / evaluation standards as per intended use: UL 991, SEMI S2-0200]



### Long-range sensing made possible with built-in optical lens

For the first time in the industry, an optical 'double coupling lens' has been incorporated directly into the fiber sensor itself. This lens maximizes the light emission efficiency, resulting in a tremendous improvement in the sensing range. Sensing ranges with small diameter fibers and ultra-small diameter fibers, which have become very popular in recent years due to the miniaturization of chip components, have been increased by 50 % over previous values achieved with other amplifiers.



### Stable long-term sensing

The newly developed four-chemical emitting element that uses the **FX-301** (red LED type) suppresses changes over long periods of time as much as possible, so that a stable light emitting level is maintained. There is very little element deterioration so that stable and accurate sensing can be maintained over long periods.

### Selectable response time

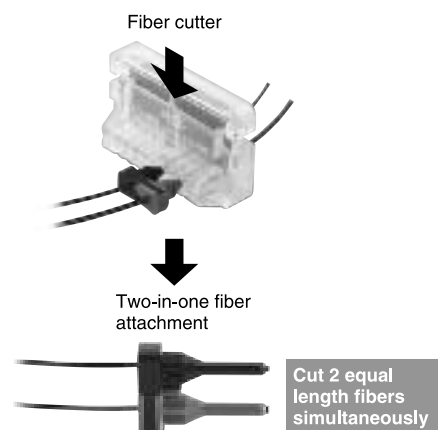
We offer 4 selectable levels to correspond with various applications: the response time 150  $\mu$ s FAST mode, the LONG mode, perfect for adverse environments, and the S-D mode, especially made for minute detection.

Selectable sensing range as per the application	
Ex.: the FX-301 fiber sensor and the FT-B8 fiber	
<b>LONG</b>	1,100 mm 43.307 in Long range mode (LONG): Response time 2 ms
<b>STD</b>	530 mm 20.866 in Standard mode (STD): Response time 250 $\mu$ s
<b>FAST</b>	400 mm 15.748 in High-speed mode (FAST): Response time 150 $\mu$ s
<b>S-D</b>	180 mm 7.087 in Reduced light intensity mode (S-D): Response time 250 $\mu$ s

※The S-D mode can be set in the red LED type only.

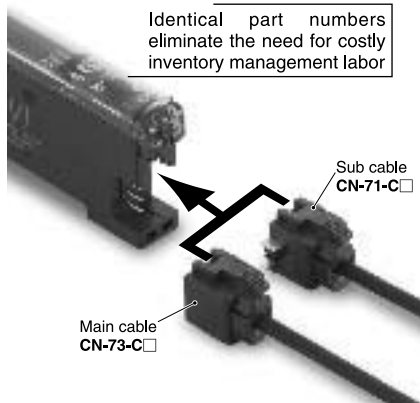
### Enhanced worksite-friendly installability

Our new fiber cutter utilizes a specially developed two-in-one fiber attachment that now makes it possible to cut two fibers simultaneously to exactly the same length. Also, since the fibers can be attached to the amplifier while being fixed in position in the two-in-one fiber attachment, sensitivity changes due to variation in the amount of fiber insertion do not occur.



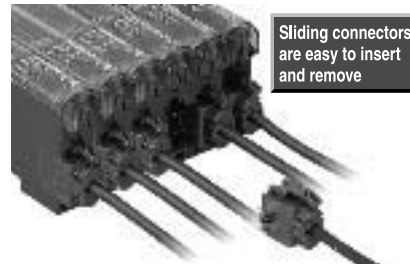
## Easy maintenance, as main and sub units are identical

Both main and sub units utilize the same amplifier body. This feature allows for easy mounting in the side-by-side configuration. The main and sub unit functions are distinguished only by the proper use of 3-core main cable and the 1-core sub cable. Moreover, by utilizing the same body for both main and sub units, inventory management and maintenance is simplified.



## Wiring- and labor-saving design allows side-by-side configuration for up to sixteen units

Up to sixteen amplifiers can be connected in a side-by-side configuration. As the sub cable contains only one output line, a great amount of wiring and space can be saved. Also, special 'sliding' connectors have been provided for all main and sub cables, which can be detached merely by releasing the lock and pulling directly back, without having to slide the amplifier body to the side. Using this connector system, only a minimal amount of space is required for regular maintenance.




## Environmentally friendly packaging













With regard to effects on the environment, we only utilize the simplest of packaging methods greatly contributing to the reduction in wastes generated by your worksite. Also, the bags are made of polyethylene, a substance that doesn't give off polluting gases when burned.



## Even beginners can quickly learn how to use the MODE NAVI



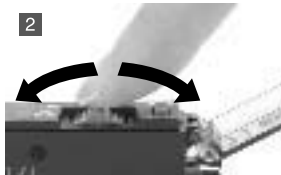



MODE NAVI uses six indicators to display the amplifier's basic operations. The current operating mode can be confirmed at a glance, so even a first time user can easily operate the amplifier without becoming confused.



<p><b>RUN</b></p> <p>This is the sensing mode. Incident light level is displayed in the digital display.</p>  <p>PUSH </p>	<p><b>TEACH</b></p> <p>This mode is for setting the threshold value.</p>  <p>PUSH </p>	<p><b>ADJ</b></p> <p>In this mode, the threshold value, once set, may be fine-tuned.</p>  <p>PUSH </p>
<p><b>PRO</b></p> <p>This mode allows the selection of further advanced functions, such as the copying of individual settings and the memory functions.</p>  <p>PUSH </p>	<p><b>TIMER</b></p> <p>This mode permits the choice of using or not using the timer.</p>  <p>PUSH </p>	<p><b>L/D ON</b></p> <p>This mode allows the selection of output operation as either Light-ON or Dark-ON.</p>  <p>PUSH </p>

## The use of only two switches makes for very simple operations

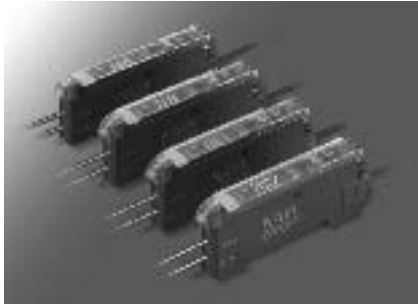
Only two switches, the large jog switch and the large MODE key, are required for operation. Depressing the large MODE key sets the 'mode selection' and 'mode cancel' functions. The large jog switch is used to select from the detailed functions available within each mode, as well as to change numerical values after the mode has been chosen.

<p><b>Large MODE key</b></p> <p>1</p>  <p> Pressing the switch selects or cancels the operating mode</p>	<p><b>Large jog switch</b></p> <p>2</p>  <p> Moving the switch from side to side allows items to be selected</p>	<p>3</p>  <p> Pressing the switch then confirms the selected setting</p>
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# FX-301

## 4 types of light sources available

In addition to our red LED (four-chemical emitting element) type, the blue, green, and infrared LED types are also provided to correspond to your specific application.



## Optical communication function lets multiple sensors be adjusted all at once

The optical communication function allows the data that is currently set to be copied and saved all at once for all amplifiers connected together from the right side. This greatly reduces troublesome setup tasks and makes setup much smoother.



## Equipped with each type of timer

These sensors are equipped with 3 types of timers, ON-delay, OFF-delay, and ONE SHOT, for compatibility to variegated environments.

### ON-delay timer

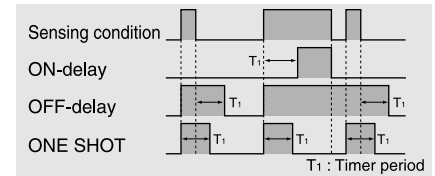
This function is useful for sensing only objects taking a long time travel.

### OFF-delay timer

This function is useful when the connected device has a slow response time.

### ONE SHOT timer

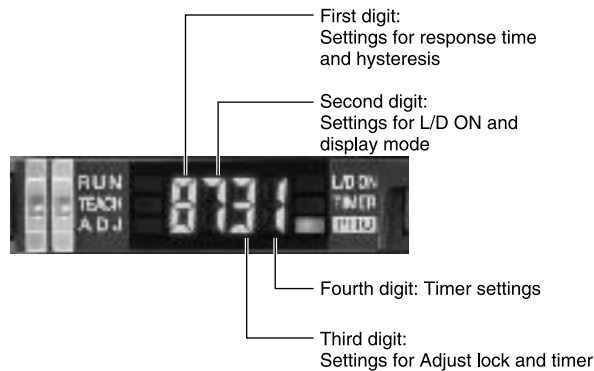
This function is useful when the input specifications of the connected device require a signal of fixed width.



## Easy code input setting

Every function can be directly set merely by the input of a four digit code (numbers) from the code table. This convenient feature is easy to set up.

In the event that settings are accidentally changed at the operating site, merely entering the correct code can restore the original settings. This results in easy and quick maintenance.



[Code setting table]

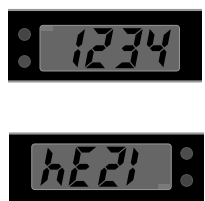
Direct code	First digit		Second digit		Third digit		Fourth digit
	Response time	Hysteresis	L/D ON	Display mode	Adjust lock	Timer	Timer setting
0	STD	H-02 (standard)	L-ON	digit	ON	OFF	OFF
1	STD	H-03 (large)	L-ON	%	ON	OFF-delay	1 ms
2	STD	H-01 (small)	L-ON	Peak hold	ON	ON-delay	3 ms
3	LONG	H-02 (standard)	L-ON	Bottom hold	ON	ONE SHOT	5 ms
4	LONG	H-03 (large)	D-ON	digit	OFF	OFF	10 ms
5	LONG	H-01 (small)	D-ON	%	OFF	OFF-delay	30 ms
6	FAST	H-02 (standard)	D-ON	Peak hold	OFF	ON-delay	50 ms
7	FAST	H-03 (large)	D-ON	Bottom hold	OFF	ONE SHOT	100 ms
8	FAST	H-01 (small)					300 ms
9	S-D	H-02 (standard)					500 ms

■ represents a description of the setting in the picture on the left.

## Invertible digital display

The digital display can be inverted as per its orientation once mounted onto the amplifier.

Conventional model



FX-301 SERIES



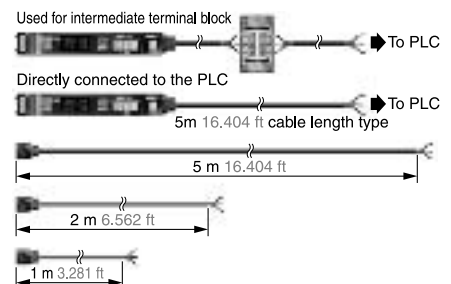
'turn OFF' status



'turn ON' status

## Selectable cable length

Made available are 3 lengths, 1 m 3.281 ft, 2 m 6.562 ft, and 5 m 16.404 ft, to suit your application requirements. This helps reduce the waste caused by cutting cables and lightens the installation workload.



## Optional units for greater freedom and control when installing

### Sensor-PLC connection system

SC SERIES

This wire-saving system enables the collective connection of up to 16 I/O devices with an MIL connector. Scattered installation is also possible with the help of a sensor separate unit.

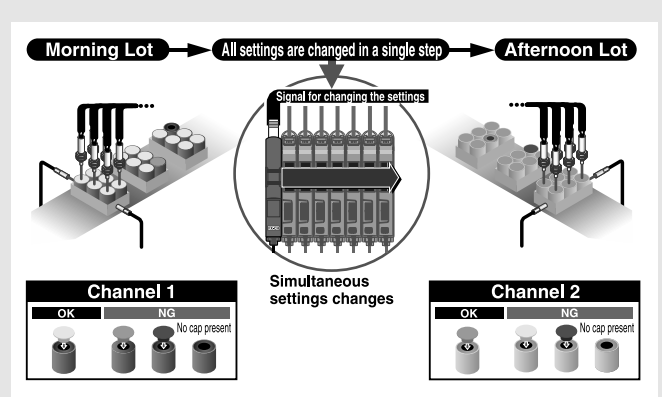
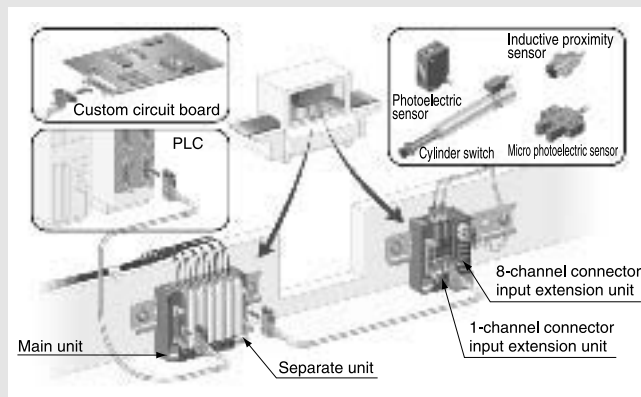


### Bank selection unit

FX-CH SERIES

Without directly manipulating the sensor itself, you can simultaneously switch up to 16 fiber sensors' settings using an external emitted signal. (Load and save)

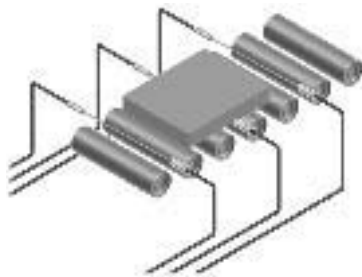
※Also possible with the FX-301 series' databank function



## APPLICATIONS

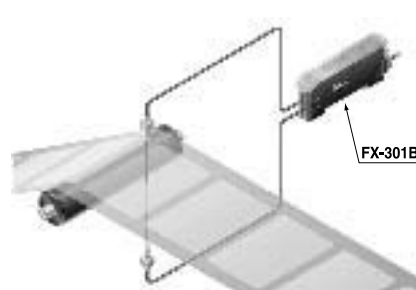
### Workpieces detection

This standard type of FX-301 using red light has a four-chemical emitting element for stable sensing over long periods.



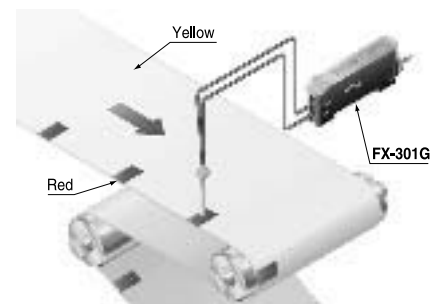
### Sensing semi-transparent stickers

The blue LED type greatly reduces the dampening rate, making it ideal for delicate sensing.



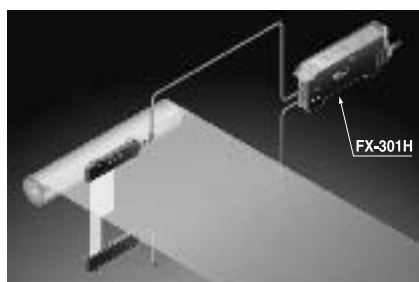
### Sensing register marks

The green LED type can accurately discriminate between red and yellow, that cannot be easily detected using red LED type.



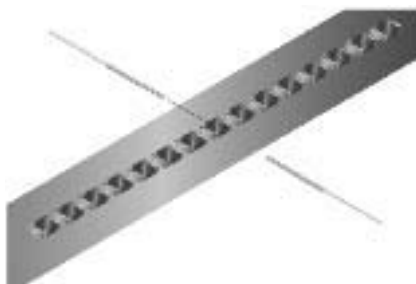
### Sensing film meandering

Infrared LED type is ideal for sensing environments with light restrictions, such as places where light-sensitive film is being handled. (The emission peak wavelength: 940 nm 0.037 mil.) It includes full-auto teaching function which allows sensitivity to be set without stopping the workpiece line.



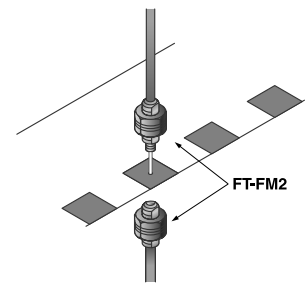
### Detecting chip component

Because of low light intensity fluctuations when detecting minute moving objects, decrease the hysteresis in PRO mode and accurate sensing will be possible in high-speed mode. This method is optimal for chip component verification in taping equipment.



### Detecting register marks on a transparent sheet


When detecting registration marks on transparent film with a thru-beam type, the S-D (reduced light intensity) mode will enable minute light intensity fluctuation sensing.



# FX-301

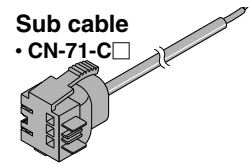
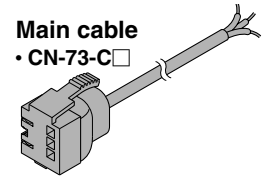
## ORDER GUIDE

**Amplifiers** Quick-connection cable is not supplied with the amplifier. Please order it separately.

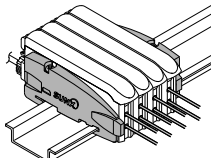
Type	Appearance	Model No.	Emitting element	Output	
Digital		<b>FX-301</b>	Red LED	NPN open-collector transistor	
		<b>FX-301B</b>	Blue LED		
		<b>FX-301G</b>	Green LED		
		<b>FX-301H</b>	Infrared LED		
		PNP output	<b>FX-301P</b>	Red LED	PNP open-collector transistor
			<b>FX-301BP</b>	Blue LED	
			<b>FX-301GP</b>	Green LED	
			<b>FX-301HP</b>	Infrared LED	

**Quick-connection cables** Quick-connection cable is not supplied with the amplifier. Please order it separately.

Type	Model No.	Description	
Main cable	<b>CN-73-C1</b>	Length: 1 m 3.281 ft	0.15 mm <sup>2</sup> 3-core cabtyre cable, with connector on one end Cable outer diameter: $\phi$ 3.0 mm $\phi$ 0.118 in
	<b>CN-73-C2</b>	Length: 2 m 6.562 ft	
	<b>CN-73-C5</b>	Length: 5 m 16.404 ft	
Sub cable	<b>CN-71-C1</b>	Length: 1 m 3.281 ft	0.15 mm <sup>2</sup> 1-core cabtyre cable, with connector on one end Cable outer diameter: $\phi$ 3.0 mm $\phi$ 0.118 in
	<b>CN-71-C2</b>	Length: 2 m 6.562 ft	
	<b>CN-71-C5</b>	Length: 5 m 16.404 ft	



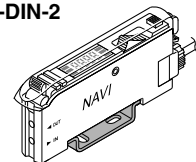
**End plates** End plates are not supplied with the amplifier. Please order separately when the amplifiers are mounted in cascade.

Appearance	Model No.	Description
	<b>MS-DIN-E</b>	When cascading multiple amplifiers, or when it moves depending on the way it is installed on a DIN rail, these end plates ensure that all amplifiers are mounted together in a secure and fully connected manner. <b>Two pcs. per set</b>

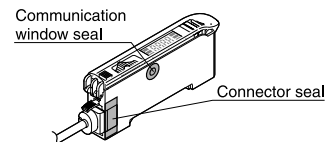
## OPTIONS

Designation	Model No.	Description
Amplifier mounting bracket	<b>MS-DIN-2</b>	Mounting bracket for amplifier
Fiber amplifier protective seal	<b>FX-MB1</b>	10 sets of 2 communication window seals and 1 connector seal Communication window seal: It prevents malfunction due to transmission signal from another amplifier, as well as, prevents effect on another amplifier. Connector seal: It prevents contact of any metal, etc., with the pins of the quick-connection cable.

**Amplifier mounting bracket**  
• MS-DIN-2



**Fiber amplifier protective seal**  
• FX-MB1



## LIST OF FIBERS

Standard fibers [Thru-beam type (one pair set)]

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1)				Min. sensing object (under the optimum condition) (Note 2)	Fiber cable length (Free-cut)	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED	Infrared LED				
Long sensing range	With lens  M14	19,500 767.715 14,000 551.180 10,000 393.700 3,800 149.606	5,400 212.598 2,700 106.299 1,900 74.803	2,800 110.236 1,400 55.118 1,000 39.370	2,400 94.488 1,200 47.244 900 35.433 (Note 3) —	φ 0.4 mm φ 0.016 in opaque object	10 m 32.808 ft	R25 mm R0.984 in	FT-FM10L
	With lens  φ2.5 φ0.098	1,600 62.992 800 31.496 580 22.835 280 11.024	400 15.748 200 7.874 130 5.118	— 200 7.874 100 3.937 65 2.559	155 6.102 77 3.031 55 2.165	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft		FT-SFM2L
	Lens mountable  M4	1,100 43.307 530 20.866 400 15.748 180 7.087	220 8.661 110 4.331 75 2.953	— 110 4.331 55 2.165 40 1.575	100 3.937 50 1.969 30 1.181	φ 0.04 mm φ 0.0016 in opaque object	2 m 6.562 ft		FT-B8
	Lens mountable  M4	1,000 39.370 480 18.898 360 14.173 168 6.614	200 7.874 100 3.937 70 2.756	— 100 3.937 50 1.969 35 1.378	90 3.543 45 1.772 28 1.102	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft (Note 4)		FT-NB8
	Lens mountable  M4							R25 mm R0.984 in	FT-FM2
	Sleeve 90 mm 3.543 in  M4 φ 1.48 φ 0.058							Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FT-FM2S
	Sleeve 40 mm 1.575 in  M4 φ 1.48 φ 0.058	780 30.709 400 15.748 280 11.024 130 5.118	150 5.906 75 2.953 40 1.575	— 70 2.756 35 1.378 24 0.945	50 1.969 25 0.984 18 0.709	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft		FT-FM2S4
	Lens mountable  M3 φ 2.5 φ 0.098							R25 mm R0.984 in	FT-T80
	Lens mountable  M3								FT-SFM2
	Lens mountable  M4	700 27.559 360 14.173 250 9.843 126 4.961	140 5.512 70 2.756 40 1.575	— 66 2.598 33 1.299 22 0.866	45 1.772 22 0.866 17 0.669	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft (Note 4)	R25 mm R0.984 in	FT-N8
	Lens mountable  M3							R25 mm R0.984 in	FT-NFM2
	Sleeve 90 mm 3.543 in  M3 φ 0.88 φ 0.035	270 10.630 140 5.512 100 3.937 49 1.929	50 1.969 25 0.984 16 0.630	— 24 0.945 12 0.472 8 0.315	16 0.630 8 0.315 5 0.197	φ 0.025 mm φ 0.0010 in opaque object	2 m 6.562 ft	Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FT-NFM2S
	Sleeve 40 mm 1.575 in  M3 φ 0.88 φ 0.035								FT-NFM2S4
	Lens mountable  φ 1.5 φ 0.059							R25 mm R0.984 in	FT-SNFM2
Elbow	Lens mountable  M4	530 20.866 230 9.055 150 5.906 80 3.150	85 3.346 42 1.654 28 1.102	— 44 1.732 22 0.866 16 0.630	32 1.260 16 0.630 12 0.472	φ 0.04 mm φ 0.0016 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-R80
	Lens mountable  φ 4 φ 0.157	2,000 78.740 1,000 39.370 800 31.496 350 13.780	400 15.748 200 7.874 130 5.118	— 200 7.874 100 3.937 65 2.559	150 5.906 75 2.953 40 1.575	φ 0.05 mm φ 0.0019 in opaque object	2 m 6.562 ft		FT-V10 <sup>New</sup>
Side-view	Lens mountable  φ 1.5 φ 0.059	400 15.748 200 7.874 140 5.512 70 2.756	80 3.150 40 1.575 28 1.102	— 40 1.575 20 0.787 14 0.551	30 1.181 15 0.591 12 0.472		2 m 6.562 ft	R25 mm R0.984 in	FT-SFM2SV2
	Sleeve part cannot be bent.  φ 1 φ 0.039	390 15.354 180 7.087 125 4.921 63 2.480	50 1.969 25 0.984 16 0.630	— 26 1.024 13 0.512 8 0.315	44 1.732 22 0.866 15 0.591	φ 0.02 mm φ 0.0008 in opaque object	1 m 3.281 ft		FT-V22
	Sleeve part cannot be bent.  φ 1 φ 0.039	175 6.890 80 3.150 60 2.362 27 1.063	28 1.102 14 0.551 10 0.394	— 14 0.551 7 0.276 5 0.197	10 0.394 5 0.197		2 m 6.562 ft		FT-V41
	Sleeve part cannot be bent.  φ 2.5 φ 0.098								

- Notes: 1) Please take care that the sensing range of the free-cut using fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.
- 2) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.  
The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.
- 3) Sensing range for a 2 m 6.562 ft long fiber. A 10 m 32.808 ft long fiber will cause damping of the beam and cannot be used.
- 4) The fiber cutter is not supplied as an accessory with FT-NB8 and FT-N8. Please order it separately.

# FX-301

## LIST OF FIBERS

### Sharp bending fibers / Flexible fibers [Thru-beam type (one pair set)]

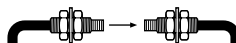


Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1)				Min. sensing object (under the optimum) (condition (Note 2))	Fiber cable length (Free-cut)	Allowable bending radius	Model No.	
		Red LED	Blue LED	Green LED	Infrared LED					
Sharp bending	Wide beam	Wide area sensing Sensing width 32 mm 1.260 in W5 X H69 X D20 W0.197 X H2.717 X D0.787	3,500 137.795	2,400 94.488	1,200 47.244	800 31.496	φ 0.3 mm φ 0.012 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WA30</b> <i>New</i>
		Wide area sensing Sensing width 11 mm 0.433 in W4.2 X H31 X D13.5 W0.165 X H1.220 X D0.531	3,500 137.795	600 23.622	300 11.811	220 8.661	φ 0.25 mm φ 0.010 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WA8</b> <i>New</i>
	Rectangular head	Easy mounting · Top sensing W3 X H8 X D12 W0.118 X H0.315 X D0.472	2,500 98.425	400 15.748	200 7.874	180 7.087	φ 0.08 mm φ 0.003 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WZ8H</b> <i>New</i>
		Easy mounting · Side sensing W3 X H12 X D8 W0.118 X H0.472 X D0.315	1,500 59.055	240 9.449	120 4.724	100 3.937	φ 0.05 mm φ 0.0020 in opaque object			<b>FT-WZ8E</b> <i>New</i>
		Easy mounting · Front sensing W8.5 X H12 X D3 W0.335 X H0.472 X D0.118	700 27.559	80 3.150	40 1.575	36 1.417	φ 0.04 mm φ 0.0016 in opaque object			<b>FT-WZ8</b> <i>New</i>
	Narrow beam	Side-view type with small light dispersion φ 4 φ 0.157 φ 3 φ 0.118	1,700 66.929	300 11.811	160 6.299	150 5.906	φ 0.06 mm φ 0.0024 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WKV8</b> <i>New</i>
		With lens · Long sensing range φ 3 φ 0.118	1,200 47.244	240 9.449	120 4.724	110 4.331	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WS8L</b>
	Standard	Lens mountable M4 φ 3 φ 0.118	570 22.441	90 3.543	56 2.205	42 1.654	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-W8</b>
		φ 2.5 φ 0.098	290 11.417	45 1.772	28 1.102	21 0.827	φ 0.05 mm φ 0.0020 in opaque object			<b>FT-WS3</b> <i>New</i>
		φ 0.039	200 7.874	30 1.181	20 0.787	15 0.591	φ 0.03 mm φ 0.0012 in opaque object			<b>FT-WS8</b>
	Small diameter	M3 φ 1.5 φ 0.059	160 6.299	16 0.630	10 0.394	8 0.315	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-W4</b>
		φ 0.039	80 3.150	8 0.315	5 0.197	4 0.157	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WS4</b>
Side-view	φ 1 φ 0.039 φ 2 φ 0.079 φ 3 φ 0.118	90 3.543	40 1.575	30 1.181	15 0.591	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft	R1 mm R0.039 in	<b>FT-WV42</b> <i>New</i>	
	Sleeve part cannot be bent.	15 0.591	—	—	—	—	—	—	—	
Flexible	Rectangular head	Easy mounting · Top sensing W3 X H8 X D12 W0.118 X H0.315 X D0.472	2,700 106.299	560 22.047	200 7.874	180 7.087	φ 0.03 mm φ 0.0012 in opaque object	2 m 6.562 ft	R4 mm R0.157 in	<b>FT-Z8H</b>
		Easy mounting · Side sensing W3 X H12 X D8 W0.118 X H0.472 X D0.315	1,600 62.992	400 15.748	200 7.874	140 5.512				<b>FT-Z8E</b>
		Easy mounting · Front sensing W8.5 X H12 X D3 W0.335 X H0.472 X D0.118	800 31.496	120 4.724	60 2.362	46 1.811				<b>FT-Z8</b>
	Standard	Lens mountable M4 φ 3 φ 0.118	650 25.591	130 5.118	70 2.756	56 2.205	φ 0.04 mm φ 0.0016 in opaque object	2 m 6.562 ft	R4 mm R0.157 in	<b>FT-P80</b>
		Lens mountable φ 1 φ 0.039 φ 2 φ 0.079	320 12.598	65 2.559	35 1.378	28 1.102				<b>FT-P60</b> <i>New</i>
	Small diameter	M3 φ 1.5 φ 0.059	250 9.843	32 1.260	18 0.709	14 0.551	φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft	R4 mm R0.157 in	<b>FT-P40</b>
		φ 0.039	100 3.937	16 0.630	9 0.354	7 0.276				<b>FT-P2</b>
		φ 0.059	120 4.724	18 0.709	10 0.394	8 0.315				<b>FT-PS1</b> <i>New</i>
		φ 0.039	80 3.150	14 0.551	8 0.315	7 0.276				
		φ 0.039	40 1.575	7 0.276	3 0.118	2 0.079				

- Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.  
 2) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type. The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.  
 3) The fiber cable length practically limits the sensing range to 3,500 mm (137.795 in) in long.

## LIST OF FIBERS

### Special use fibers [Thru-beam type (one pair set)]



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1)				Min. sensing object (under the optimum) (condition (Note 2))	Fiber cable length (Free-cut)	Allowable bending radius	Model No.	
		Red LED	Blue LED	Green LED	Infrared LED					
Wide beam						φ 0.3 mm φ 0.012 in opaque object	2 m 6.562 ft	R10 mm R0.394 in	<b>FT-A30</b> <i>New</i>	
										φ 0.25 mm φ 0.010 in opaque object
Array						Horizontal: φ 0.025 mm φ 0.0010 in opaque object  Vertical: φ 0.45 mm φ 0.018 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	<b>FT-AFM2</b>	
									<b>FT-AFM2E</b>	
Narrow beam						φ 0.06 mm φ 0.0024 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	<b>FT-K8</b>	
									<b>FT-KV8</b>	
									φ 0.02 mm φ 0.0008 in opaque object	2 m 6.562 ft
					φ 0.02 mm φ 0.0008 in opaque object	500 mm 19.685 in	R5 mm R0.197 in	<b>FT-E12</b>		
								<b>FT-E22</b>		
Tough flexible						φ 0.05 mm φ 0.0020 in opaque object	1 m 3.281 ft	R10 mm R0.394 in	<b>FT-P81X</b> <i>New</i>	

- Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.
- 2) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.  
The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.
- 3) The fiber cable length practically limits the sensing range to 3,500 mm 137.795 in long.



# FX-301

## LIST OF FIBERS

### Environment resistant fibers [Thru-beam type (one pair set)]



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1)				Min. sensing object (under the optimum) (condition (Note 2))	Fiber cable length (Free-cut)	Allowable bending radius	Model No.	
		Red LED	Blue LED	Green LED	Infrared LED					
Environment resistant	350 °C 662 °F Lens mountable 	550 21.654 280 11.024 200 7.874	100 3.937 50 1.969 35 1.378	50 1.969 25 0.984 18 0.709	420 16.535 210 8.268 160 6.299	φ0.04 mm φ0.0016 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-H35-M2	
	350 °C 662 °F Sleeve 60 mm 2.362 in M4 φ2.1 φ0.083 	90 3.543	—	—	—	—	—	Fiber R25 mm R0.984 in Sleeve R19 mm R0.394 in	FT-H35-M2S6	
	Allows flexible wiring 200 °C 392 °F Lens mountable 	310 12.205 140 5.512 100 3.937 50 1.969	44 1.732 22 0.866 14 0.551	22 0.866 11 0.433 7 0.276	220 8.661 110 4.331 70 2.756	φ0.02 mm φ0.0008 in opaque object	1 m 3.281 ft 2 m 6.562 ft	R10 mm R0.394 in	FT-H20W-M1 FT-H20W-M2	
	200 °C 392 °F Lens mountable 	550 21.654 280 11.024 200 7.874 90 3.543	100 3.937 50 1.969 35 1.378	50 1.969 25 0.984 18 0.709	420 16.535 210 8.268 160 6.299	φ0.04 mm φ0.0016 in opaque object	1 m 3.281 ft	R25 mm	FT-H20-M1	
	130 °C 266 °F Lens mountable 	880 34.646 440 17.323 300 11.811 155 6.102	72 2.835 36 1.417 26 1.024	32 1.260 16 0.630 10 0.394	70 2.756 35 1.378 25 0.984	φ0.06 mm φ0.0024 in opaque object	2 m 6.562 ft	R0.984 in	FT-H13-FM2	
	Easy mounting · Rectangular head SEMI S2 compliant W7 × H15 × D13 W0.276 × H0.591 × D0.512 	3,500 137.795 1,500 59.055 1,000 39.370 530 20.866	320 12.598 160 6.299 120 4.724	160 6.299 80 3.150 60 2.362	320 12.598 160 6.299 120 4.724	φ4 mm φ0.157 in opaque object	2 m 6.562 ft	R25 mm R0.984 in	FT-Z802Y	
		3,500 137.795 1,500 59.055 1,000 39.370 530 20.866	160 6.299 80 3.150 50 1.969	160 6.299 80 3.150 50 1.969	400 15.748 200 7.874 150 5.906	φ0.08 mm φ0.003 in opaque object	2 m 6.562 ft (Note 3)	R30 mm R1.181 in	FT-L8Y FT-V8Y	
	Side-view φ5.5 φ0.217 	800 31.496 400 15.748 280 11.024 140 5.512	120 4.724 60 2.362 35 1.378	80 3.150 40 1.575 25 0.984	75 2.953 38 1.496 24 0.945	—	—	—	—	
	Vacuum	Lens mountable 	470 18.504 230 9.055 165 6.496 80 3.150	100 3.937 50 1.969 30 1.181	46 1.811 23 0.906 16 0.630	70 2.756 35 1.378 22 0.866	φ0.02 mm φ0.0008 in opaque object	1 m 3.281 ft	R200 mm R7.874 in	FT-6V
			220 8.661 100 3.937 75 2.953 35 1.378	36 1.417 18 0.709 12 0.472	18 0.709 9 0.354 6 0.236	28 1.102 14 0.551 10 0.394	—	—	R30 mm R1.181 in	FT-60V

Notes: 1) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.  
2) The minimum sensing object size is the value for red LED type. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type. The optimum condition is the condition when the sensitivity is set so that the sensing output just changes to light incident operation in the object absent condition.  
3) The allowable cutting range is 500 mm 19.685 in from the end that the amplifier inserted.

### The vacuum type fiber must be used with the following products as a set.

FT-J6: Fiber at atmospheric side (one pair set) FV-BR1: Photo-terminal (one pair set)

### Semi-standard fibers (Custom made per order)

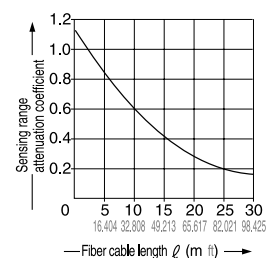
The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☒) or the sleeve length (symbol ☐) from the table below.

Type	Basic model No.	☒ Fiber cable length (Unit: m ft)	☐ Sleeve length (Unit: cm in)
Standard threaded head (free-cut)	FT-FM ☒	3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617, 25 82.021, 30 98.425	—
	With sleeve FT-FM ☒-S ☐	2 6.562 (Note), 3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617, 25 82.021, 30 98.425	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.150, 9 3.543, 10 3.937, 11 4.331, 12 4.724
With large diameter lens	FT-FM ☒ L	20 65.617, 30 98.425	4.724
Small diameter threaded head with sleeve (free-cut)	FT-NFM2-S ☐	—	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.150, 9 3.543, 10 3.937, 11 4.331, 12 4.724
Wide beam	FT-WA30- ☒	5 16.404	—
	FT-WA8- ☒		—
	FT-A30- ☒		—
	FT-A8- ☒		—
200°C 392°F heat-resistant	FT-H20-M ☒	2 6.562, 3 9.843	—
350°C 662°F heat-resistant	FT-H35-M ☒	3 9.843	—
Chemical-resistant	FT-Z80 ☒ Y	5 16.404, 7 22.966	—

Note: The standard fiber has a 2 m 6.562 ft fiber cable length and a 4 cm 1.575 in or 9 cm 3.543 in sleeve length.

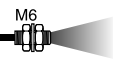
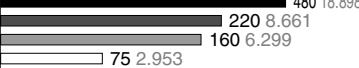
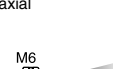
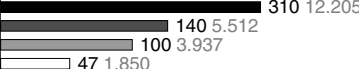
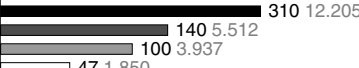
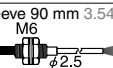


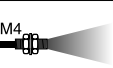
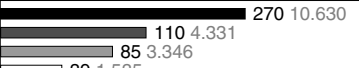


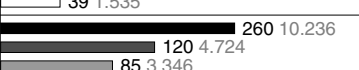

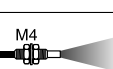
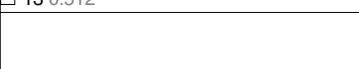

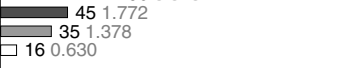


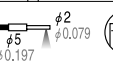
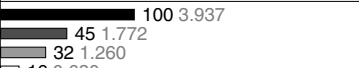
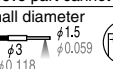

### Correlation between sensing range attenuation coefficient and fiber cable length

The longer the fiber cable, the shorter the sensing range.



## LIST OF FIBERS

### Standard fibers (Reflective type)

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2)				Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length ✂: Free-cut	Allowable bending radius	Model No.			
		Red LED	Blue LED	Green LED	Infrared LED							
Standard	 M6 Long sensing range	 480 18.898 220 8.661 160 6.299 75 2.953	80 3.150 40 1.575 26 1.024	42 1.654 21 0.827 14 0.551	26 1.654 13 0.827 9 0.551	φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	FD-B8			
		 Coaxial M6	 310 12.205 140 5.512 100 3.937 47 1.850	46 1.811 23 0.906 15 0.591	24 0.945 12 0.472 8 0.315	90 3.543 45 1.772 30 1.181	φ 0.02 mm φ 0.0008 in gold wire	✂ 500 mm 19.685 in ✂ 2 m 6.562 ft	R25 mm R0.984 in	FD-5		
			 310 12.205 140 5.512 100 3.937 47 1.850	46 1.811 23 0.906 15 0.591	24 0.945 12 0.472 8 0.315	20 0.787 10 0.394 7 0.276				FD-FM2		
	 Sleeve 90 mm 3.543 in M6 φ 0.098	 270 10.630 110 4.331	46 1.811 23 0.906 15 0.591	24 0.945 12 0.472 8 0.315	20 0.787 10 0.394 7 0.276	φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft	Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	FD-FM2S			
		 85 3.346 39 1.535	—	—	—				FD-FM2S4			
	 M4 Small diameter M3 φ 0.118	 270 10.630 110 4.331 85 3.346 39 1.535	46 1.811 23 0.906 15 0.591	24 0.945 12 0.472 8 0.315	20 0.787 10 0.394 7 0.276	φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	FD-T80			
		 90 3.543 45 1.772 35 1.378 16 0.630	16 0.630 8 0.315 5 0.197	8 0.315 4 0.157 2 0.079	6 0.236 3 0.118 2 0.079				FD-T40			
		 270 10.630 110 4.331 85 3.346 39 1.535	46 1.811 23 0.906 15 0.591	24 0.945 12 0.472 8 0.315	20 0.787 10 0.394 7 0.276				FD-S80			
		 260 10.236 120 4.724 85 3.346 42 1.654	46 1.811 23 0.906 15 0.591	24 0.945 12 0.472 8 0.315	20 0.787 10 0.394 7 0.276				φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft (Note 4)	R25 mm R0.984 in	FD-N8
		 75 2.953 38 1.496 28 1.102 13 0.512	16 0.630 8 0.315 5 0.197	8 0.315 4 0.157 2 0.079	4 0.157 2 0.079 1.5 0.059							FD-N4
		 M4 Sleeve 90 mm 3.543 in M4 φ 1.48 φ 0.058	 90 3.543 45 1.772	16 0.630 8 0.315 5 0.197	8 0.315 4 0.157 2 0.079				6 0.236 3 0.118 2 0.079	φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in
	 90 3.543 45 1.772		—	—	—	FD-NFM2S						
	 35 1.378 16 0.630		—	—	—	FD-NFM2S4						
	 35 1.378 16 0.630		—	—	—	FD-SNFM2						
	 185 7.283 85 3.346 60 2.362 30 1.181		32 1.260 16 0.630 10 0.394	16 0.630 8 0.315 5 0.197	10 0.472 5 0.197 3 0.118	φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	FD-R80			
	Side-view	 #2 φ 5 φ 0.079 φ 0.197 Sleeve part cannot be bent.	 100 3.937 45 1.772 32 1.260 16 0.630	14 0.551 7 0.276 4 0.157	7 0.276 3.5 0.138	4 0.157	φ 0.02 mm φ 0.0008 in gold wire	✂ 2 m 6.562 ft	R25 mm R0.984 in	FD-SFM2SV2		
			 Small diameter #3 φ 1.5 φ 0.059 φ 0.118 Sleeve part cannot be bent.	 55 2.165 25 0.984 17 0.669 9 0.354	6 0.236 3 0.118	3 0.118			—	—	—	FD-V41

Notes: 1) The sensing range is specified for white non-glossy paper (FD-B8, FD-5, FD-FM2, FD-FM2S, FD-FM2S4, FD-N8, FD-T80, FD-S80 and FD-R80: 400 × 400 mm 15.748 × 15.748 in, FD-T40, FD-N4, FD-NFM2, FD-NFM2S, FD-NFM2S4, FD-SNFM2, FD-SFM2SV2 and FD-V41: 200 × 200 mm 7.874 × 7.874 in) as the object.

2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.


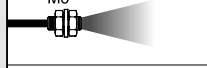
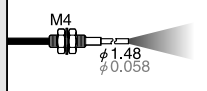
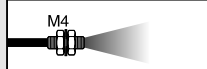
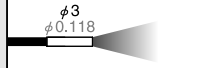
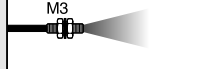
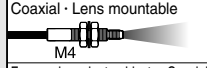
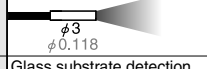

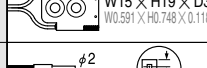
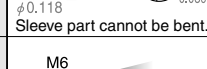
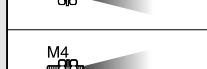

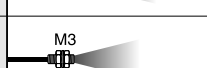

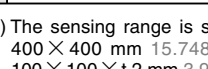
3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.  
Also, note that the corresponding setting distance is different from the rated sensing distance.

4) The fiber cutter is not supplied as an accessory with FD-N8 and FD-N4. Please order it separately.

# FX-301

## LIST OF FIBERS

### Sharp bending fibers / Flexible fibers (Reflective type)

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2)				Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length : Free-cut	Allowable bending radius	Model No.	
		Red LED	Blue LED	Green LED	Infrared LED					
Sharp bending	Long sensing range - Rectangular head  W: 9.2 × H: 5 × D: 15 mm W: 0.205 × H: 0.174 × D: 0.591 in	20 to 480 0.787 to 18.898 20 to 230 0.787 to 9.055 20 to 170 0.787 to 6.693 25 to 100 0.984 to 3.937	— — — —	— — — —	— — — —	φ 0.3 mm φ 0.012 in copper wire	2 m 6.562 ft	R1 mm R0.039 in	<b>FD-WKZ1</b> <i>New</i>	
	M6 	190 7.480 90 3.543 60 2.362 32 1.260	23 0.906 11 0.433 8 0.315 —	14 0.551 7 0.276 4 0.157 —	11 0.433 5.5 0.217 3 0.118 —	φ 0.02 mm φ 0.0008 in gold wire	2 m 6.562 ft	R1 mm R0.039 in	<b>FD-W8</b>	
	Sleeve 40 mm 1.575 in M4  φ 1.48 φ 0.058	30 1.181 15 0.591 12 0.472 5 0.197	5 0.197 2.5 0.098 1.5 0.059 —	3 0.118 1.5 0.059 1 0.039 —	2 0.079 1 0.039 — —				Fiber R1 mm R0.039 in Sleeve R10 mm R0.394 in	<b>FD-W44</b>
	M4 	190 7.480 90 3.543 60 2.362 32 1.260	23 0.906 11 0.433 8 0.315 —	14 0.551 7 0.276 4 0.157 —	11 0.433 5.5 0.217 3 0.118 —				R1 mm R0.039 in	<b>FD-WT8</b>
	φ 3 φ 0.118 	30 1.181 15 0.591 12 0.472 5 0.197	5 0.197 2.5 0.098 1.5 0.059 —	3 0.118 1.5 0.059 1 0.039 —	2 0.079 1 0.039 — —					<b>FD-WS8</b>
	M3 	30 1.181 15 0.591 12 0.472 5 0.197	5 0.197 2.5 0.098 1.5 0.059 —	3 0.118 1.5 0.059 1 0.039 —	2 0.079 1 0.039 — —					<b>FD-WT4</b>
	High precision	Small spot for sensing minute objects Coaxial · Lens mountable M4  φ 0.118	65 2.559 32 1.260 25 0.984 11 0.433	11 0.433 5 0.197 3 0.118 —	6 0.236 3 0.118 2 0.079 —	φ 0.02 mm φ 0.0008 in gold wire	2 m 6.562 ft	R2 mm R0.079 in	<b>FD-WG4</b>	
	For sensing minute objects · Coaxial φ 3 φ 0.118 	25 0.984 11 0.433	3 0.118 —	2 0.079 —	1.5 0.059 —				<b>FD-WSG4</b>	
	Fixed-focus reflective	Glass substrate detection  W24 × H21 × D4 W: 0.945 × H: 0.827 × D: 0.157	6.5 to 14 0.256 to 0.551 (Convergent point 8 0.315) 7 to 12 0.276 to 0.472 (Convergent point 8 0.315) 7.5 to 12 0.295 to 0.472 (Convergent point 8 0.315) Cannot use	— — — —	— — — —	φ 1.9 mm φ 0.075 in metal pipe (gray)	2 m 6.562 ft	R1 mm R0.039 in	<b>FD-WL41</b> <i>New</i>	
		Specular object detection  W15 × H19 × D3 W: 0.591 × H: 0.748 × D: 0.118	0.6 to 3.5 0.024 to 0.138 (Convergent point 2 0.079) 0.9 to 2.7 0.035 to 0.106 (Convergent point 2 0.079) 1 to 2.5 0.039 to 0.098 (Convergent point 2 0.079) Cannot use	— — — —	— — — —				— — — —	φ 0.08 mm φ 0.003 in gold wire
	Side-view	φ 2 φ 3 φ 0.079 φ 0.118 φ 0.039 Sleeve part cannot be bent. 	15 0.591 7 0.276 5 0.197 Cannot use	— — — —	— — — —	φ 0.02 mm φ 0.0008 in gold wire	2 m 6.562 ft	R1 mm R0.039 in	<b>FD-WV42</b> <i>New</i>	
	Flexible	Standard	M6 	220 8.661 100 3.937 70 2.756 35 1.378	40 1.575 20 0.787 13 0.512 —				20 0.787 10 0.394 7 0.276 —	18 0.709 9 0.354 6 0.236 —
		M4 	90 3.543 45 1.772 30 1.181 16 0.630	20 0.787 10 0.394 6 0.236 —	10 0.394 5 0.197 3 0.118 —	8 0.315 4 0.157 2.5 0.098 —	<b>FD-P60</b>			
		φ 3 φ 0.118 	36 1.417 18 0.709 14 0.551 6 0.236	5 0.197 2.5 0.098 1.5 0.059 —	3 0.118 1.5 0.059 1 0.039 —	2 0.079 1 0.039 — —	<b>FD-P50</b>			
		Small diameter	M3 	50 1.969 25 0.984 19 0.748 9 0.354	8 0.315 4 0.157 2.5 0.098 —	4 0.157 2 0.079 1.5 0.059 —	7 0.276 3.5 0.138 2 0.079 —	1 m 3.281 ft	<b>FD-P40</b>	
φ 1.5 φ 0.059 		50 1.969 25 0.984 19 0.748 9 0.354	8 0.315 4 0.157 2.5 0.098 —	4 0.157 2 0.079 1.5 0.059 —	7 0.276 3.5 0.138 2 0.079 —	<b>FD-P2</b>				

Notes: 1) The sensing range is specified for white non-glossy paper [100 × 100 mm 3.937 × 3.937 in (FD-WKZ1, FD-W8, FD-WT8, FD-WS8 and FD-P80: 400 × 400 mm 15.748 × 15.748 in, FD-WG4, FD-WSG4, FD-P60 and FD-P50: 200 × 200 mm 7.874 × 7.874 in, FD-WL41: glass substrate 100 × 100 × t 2 mm 3.937 × 3.937 × t 0.472 in)] as the object.

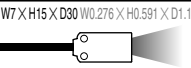
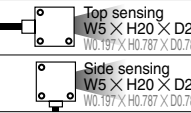
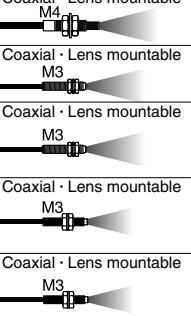
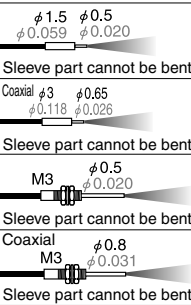
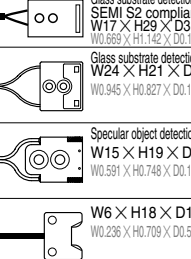
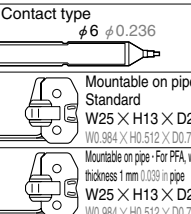
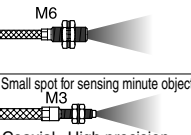
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.

3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type.

Also, note that the corresponding setting distance is different from the rated sensing distance. However, with the fixed-focus reflective type, when the sensitivity is at MAX., it is only possible to detect the minimum size of the sensing object at a distance corresponding to the convergent point.

## LIST OF FIBERS

### Special use fibers (Reflective type)

Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2)				Min. sensing object (at the maximum sensitivity (Note 3))	Fiber cable length (Note 4)	Allowable bending radius	Model No.		
		Red LED		Blue LED	Green LED					Infrared LED	
Special use	Wide beam 	W7 X H15 X D30 W0.276 X H0.591 X D1.181	200 7.874 150 5.906 100 3.937 50 1.969	25 0.984 15 0.591	—	—	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-A15 <i>New</i>	
		Array 	Top sensing W5 X H20 X D20 W0.197 X H0.787 X D0.787	220 8.661 110 4.331 78 3.071 39 1.535	40 1.575 20 0.787 13 0.512	18 0.709 9 0.354 5 0.197	12 0.472 6 0.236 4 0.157	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-AFM2 FD-AFM2E
	Side sensing W5 X H20 X D20 W0.197 X H0.787 X D0.787		—	—	—	—	—	—	—	—	
	High precision 	Coaxial · Lens mountable M4	110 4.331 55 2.165 42 1.654 19 0.748	22 0.866 11 0.433 8 0.315	12 0.472 6 0.236 4 0.157	7 0.276 3.5 0.138 2 0.079	φ0.02 mm φ0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	FD-G4 FD-G6 <i>New</i>	
		Coaxial · Lens mountable M3	38 1.496 18 0.709 14 0.551 6 0.236	6 0.236 3 0.118 2 0.079	3 0.118 1.5 0.059 1 0.039	10 0.394 5 0.197 3 0.118	—	—	—	—	
		Coaxial · Lens mountable M3	25 0.984 12 0.472 9 0.354 5 0.197	5 0.197 2 0.079 1 0.039	2 0.079 1 0.039	6 0.236 3 0.118 2 0.079	—	—	—	—	
		Coaxial · Lens mountable M3	15 0.591 8 0.315 5 0.197 3 0.118	2 0.079 1 0.039	1 0.039	3 0.118 1.5 0.059 1 0.039	φ0.04 mm φ0.0016 in gold wire	500 mm 19.685 in	R10 mm R0.394 in	FD-EG1 FD-EG2 <i>New</i> FD-EG3 <i>New</i>	
		Ultra-small diameter 	φ1.5 φ0.5 φ0.059 φ0.020	11 0.433 6 0.236 4 0.157 1 0.039	2 0.079 1 0.039	1 0.039	1 0.039	—	—	—	—
			Sleeve part cannot be bent.	—	—	—	—	—	—	—	—
	Coaxial φ3 φ0.65 φ0.118 φ0.026		45 1.772 23 0.906 17 0.669 7 0.276	6 0.236 3 0.118 2 0.079	3 0.118 1.5 0.059 1 0.039	6 0.236 3 0.118 2 0.079	φ0.02 mm φ0.0008 in gold wire	500 mm 19.685 in	R25 mm R0.984 in	FD-E12 FD-E22 FD-EN500S1	
	Sleeve part cannot be bent.		—	—	—	—	—	—	—	—	
	Coaxial φ0.8 M3 φ0.031		38 1.496 18 0.709 14 0.551 6 0.236	6 0.236 3 0.118 2 0.079	3 0.118 1.5 0.059 1 0.039	4 0.157 2 0.079 1.5 0.059	—	—	—	—	
	Sleeve part cannot be bent.		—	—	—	—	—	—	—	—	
	Fixed-focus reflective 	Glass substrate detection SEMI S2 compliant W17 X H29 X D3.8 W0.669 X H1.142 X D0.153	0 to 20 0 to 0.787	—	—	—	(LCD glass)	—	R4 R0.157	FD-L43	
		Glass substrate detection W24 X H21 X D4 W0.945 X H0.827 X D0.157	2.5 to 18 0.098 to 0.709 (Convergent point 8 0.315) 3 to 16 0.118 to 0.630 (Convergent point 8 0.315) 3.5 to 15 0.138 to 0.591 (Convergent point 8 0.315) Cannot use	—	—	—	φ0.06 mm φ0.0024 in gold wire	2 m 6.562 ft	R10 mm R0.394 in	FD-L41 FD-L42	
		Specular object detection W15 X H19 X D3 W0.591 X H0.748 X D0.118	0.5 to 4 0.020 to 0.157 (Convergent point 2 0.079) 1 to 3.8 0.039 to 0.150 (Convergent point 2 0.079) 1.3 to 3.5 0.051 to 0.138 (Convergent point 2 0.079) Cannot use	—	—	—	φ0.03 mm φ0.0012 in gold wire	—	—	—	
		W6 X H18 X D14 W0.236 X H0.709 X D0.551	2.5 to 18 0.098 to 0.709 (Convergent point 6 0.236) 4 to 12 0.157 to 0.472 (Convergent point 6 0.236) 4.5 to 11 0.177 to 0.433 (Convergent point 6 0.236) 4.8 to 9.5 0.189 to 0.374 (Convergent point 6 0.236)	45φ0.45 0.177 to 0.374 5φ0.197 0.138 to 0.315 55φ0.8 0.271 to 0.315	—	—	—	φ0.02 mm φ0.0008 in gold wire	—	—	FD-L4
	Liquid level sensing 	Contact type φ6 φ0.236	—	—	—	—	(Liquid)	2 m 6.562 ft (Note 4)	Protective tube R40 mm R1.575 in Fiber R15 mm R0.591 in	FD-F8Y	
		Mountable on pipe Standard W25 X H13 X D20 W0.984 X H0.512 X D0.787	Applicable pipe diameter: Outer dia. φ6 to φ26 mm φ0.236 to φ1.024 in transparent pipe [PVC, fluorine resin, polycarbonate, acrylic, glass, wall thickness 1 to 3 mm 0.039 to 0.118 in]	—	—	—	—	(Liquid)	2 m 6.562 ft 5 m 16.404 ft	R10 mm R0.394 in	FD-F41 FD-F91
			Mountable on pipe · For PFA, wall thickness 1 mm 0.039 in pipe W25 X H13 X D20 W0.984 X H0.512 X D0.787	Applicable pipe diameter: Outer dia. φ6 to φ26 mm φ0.236 to φ1.024 in transparent pipe [PFA (fluorine resin) or equivalently transparent pipe, wall thickness 1 mm 0.039 in]	—	—	—	—	(Liquid)	2 m 6.562 ft 5 m 16.404 ft	—
—				—	—	—	—	—	—	—	—
Tough flexible 	M6	185 7.283 80 3.150 60 2.362 35 1.378	32 1.260 16 0.630 10 0.394	16 0.630 8 0.315 5 0.197	30 1.181 15 0.591 10 0.394	φ0.02 mm φ0.0008 in gold wire	1 m 3.281 ft	R10 mm R0.394 in	FD-P81X <i>New</i>		
	Small spot for sensing minute objects M3	90 3.543 45 1.772 35 1.378	22 0.866 11 0.433 6 0.236	12 0.472 6 0.236 4 0.157	18 0.709 9 0.354 5 0.197	—	—	—	FD-G6X <i>New</i>		

Notes: 1) The sensing range is specified for white non-glossy paper [100 X 100 mm 3.937 X 3.937 in (FD-A15, FD-G4, FD-G6X: 200 X 200 mm 7.874 X 7.874 in, FD-AFM2, FD-AFM2E, FD-P81X: 400 X 400 mm 15.748 X 15.748 in, FD-L43: glass substrate 76 X 52 X t 1.1 mm 2.992 X 2.047 X t 0.043 in, FD-L41: glass substrate 100 X 100 X t 2 mm 3.937 X 3.937 X t 0.079 in)] as the object.

2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.

3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type. Also, note that the corresponding setting distance is different from the rated sensing distance. However, with the fixed-focus reflective type, when the sensitivity is at MAX., it is only possible to detect the minimum size of the sensing object at a distance corresponding to the convergent point.

4) Following is the allowable cutting range from the end that the amplifier is inserted FD-F8Y: 1,000 mm 39.370 in, FD-G6X: 700 mm 27.559 in.

# FX-301

## LIST OF FIBERS

### Environment resistant fibers (Reflective type)



Type	Shape of fiber head (mm in)	Sensing range (mm in) (Note 1, 2)				Min. sensing object (at the maximum sensitivity) (Note 3)	Fiber cable length (Free-cut)	Allowable bending radius	Model No.
		Red LED	Blue LED	Green LED	Infrared LED				
Environment resistant	350 °C 662 °F · Coaxial 					φ 0.02 mm φ 0.0008 in gold wire	2 m 6.562 ft	R25 mm R0.984 in	<b>FD-H35-M2</b>
	350 °C 662 °F · Sleeve 60 mm 2.362 in 	270 10.630 140 5.512 100 3.937 47 1.850	36 1.417 18 0.709 12 0.472	20 0.787 10 0.394 7 0.276	140 5.512 70 2.756 45 1.772			Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	<b>FD-H35-M2S6</b>
	200 °C 392 °F · Coaxial 						1 m 3.281 ft	R25 mm R0.984 in	<b>FD-H20-M1</b>
	350 °C 662 °F · Sleeve 90 mm 3.543 in 	160 6.299 80 3.150 57 2.244 26 1.024	22 0.866 11 0.433 7 0.276	12 0.472 6 0.236 4 0.157	80 3.150 40 1.575 28 1.102		Fiber R25 mm R0.984 in Sleeve R10 mm R0.394 in	<b>FD-H35-20S</b>	
	200 °C 392 °F · Coaxial 	270 10.630 140 5.512 100 3.937 47 1.850	36 1.417 18 0.709 12 0.472	20 0.787 10 0.394 7 0.276	140 5.512 70 2.756 45 1.772		1 m 3.281 ft	R25 mm R0.984 in	<b>FD-H20-21</b>
	300 °C 572 °F · Glass substrate detection Fixed-focus reflective type 	0 to 15 0 to 0.591 0 to 10 0 to 0.394	—	—	—		2 m 6.562 ft	R25 mm R0.984 in	<b>FD-H30-L32</b>
	180 °C 356 °F · Glass substrate detection Fixed-focus reflective type 	1 to 8 0.039 to 0.315 2 to 6 0.079 to 0.236	—	—	—		2 m 6.562 ft	R25 mm R0.984 in	<b>FD-H18-L31</b>
	130 °C 266 °F 	310 12.205 140 5.512 100 3.937 47 1.850	20 0.787 11 0.433 7 0.276	20 0.787 11 0.433 7 0.276	25 0.984 12 0.472 8 0.315		2 m 6.562 ft	R25 mm R0.984 in	<b>FD-H13-FM2</b>
	Vacuum 	165 6.496 75 2.953 52 2.047 26 1.024	26 1.024 13 0.512 9 0.354	14 0.551 7 0.276 4 0.157	21 0.827 10 0.394 6 0.236		1 m 3.281 ft	R200 mm R7.874 in	<b>FD-6V</b>

- Notes: 1) The sensing range is specified for white non-glossy paper [400 × 400 mm 15.748 × 15.748 in (FD-H30-L32, FD-H18-L31: glass substrate 50 × 50 mm 1.969 × 1.969 in)] as the object.  
2) Please take care that the sensing range of the free-cut type fiber may be reduced by 20 % max. depending upon how the fiber is cut. In addition, the infrared type is easily affected by humidity, so contact our office if using these sensors in environments with high humidity or where humidity levels can fluctuate.  
3) The minimum sensing object size is the value for red LED type at maximum sensitivity. Please contact our office for information on the minimum sensing object size if using amplifiers other than red LED type. Also, note that the corresponding setting distance is different from the rated sensing distance.

### The vacuum type fiber must be used with the following products as a set.

- FT-J6: Fiber at atmospheric side (one pair set)
- FV-BR1: Photo-terminal (one pair set)

### Semi-standard fibers (Custom made per order)

The fiber cable length or sleeve length of the standard fibers can be modified at your request. Select the fiber cable length (symbol ☒) or the sleeve length (symbol ☐) from the table below.

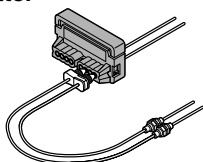
Type	Basic model No.	☒ Fiber cable length (Unit: m ft)	☐ Sleeve length (Unit: cm in)
Standard threaded head (free-cut)	<b>FD-FM</b> ☒	3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617	—
	With sleeve <b>FD-FM</b> ☒-S ☐	2 6.562 (Note), 3 9.843, 4 13.123, 5 16.404, 10 32.808, 15 49.213, 20 65.617	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.150, 9 3.543, 10 3.937, 11 4.331, 12 4.724
Small diameter threaded head with sleeve (free-cut)	<b>FD-NFM2-S</b> ☐	—	1 0.394, 2 0.787, 3 1.181, 4 1.575, 5 1.969, 6 2.362, 7 2.756, 8 3.150, 9 3.543, 10 3.937, 11 4.331, 12 4.724
200°C 392°F heat-resistant	<b>FD-H20-M</b> ☒	2 6.562, 3 9.843	—
350°C 662°F heat-resistant	<b>FD-H35-M</b> ☒	3 9.843	—

Note: The standard fiber has a 2 m 6.562 ft fiber cable length and a 4 cm 1.575 in or 9 cm 3.543 in sleeve length.

### Accessories (attached with fibers)

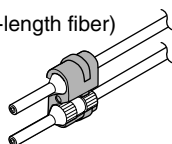
#### Fiber cutter

- FX-CT2

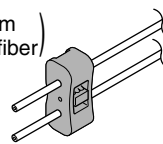


#### Fiber attachment

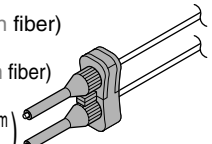
- FX-AT2 (for fixed-length fiber)



- FX-AT3 (for φ 2.2 mm φ 0.087 in fiber)



- FX-AT4 (for φ 1 mm φ 0.039 in fiber)
- FX-AT5 (for φ 1.3 mm φ 0.051 in fiber)
- FX-AT6 (for φ 1 mm φ 0.039 in and φ 1.3 mm φ 0.051 in mixed fiber)

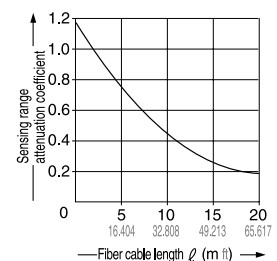


Notes: 1) Fiber cutter is not supplied as accessory along with FT-NB8, FT-N8, FD-N8 and FD-N4. Please order it separately.

2) The fiber attachment is not attached with FT-N8/NB8/P80 and FD-N8/P80. The previous FX-AT10 attachment is attached with FD-N4.

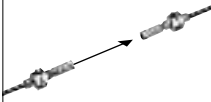
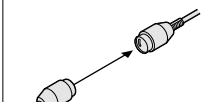

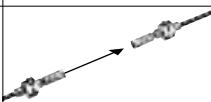
### Correlation between sensing range attenuation coefficient and fiber cable length

The longer the fiber cable, the shorter the sensing range.




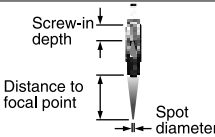
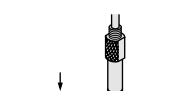
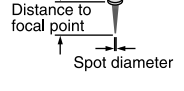
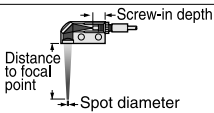
## FIBER OPTIONS

### Lens (For thru-beam type fiber)

Designation	Model No.	Description																																																																														
For thru-beam type fiber	Expansion lens (Note 1) <b>FX-LE1</b>		Increases the sensing range by 5 times or more. • Ambient temperature: - 60 to + 350 °C - 76 to + 662 °F																																																																													
			Tremendously increases the sensing range with large diameter lenses. • Ambient temperature: - 60 to + 350 °C - 76 to + 662 °F																																																																													
			Beam axis is bent by 90 °. • Ambient temperature: - 60 to + 300 °C - 76 to + 572 °F																																																																													
			Sensing range increases by 15 times or more. • Ambient temperature: - 40 to + 120 °C - 40 to + 248 °F																																																																													
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Notes: 1) Be careful when installing the thru-beam type fiber equipped with the expansion lens, as the beam envelope becomes narrow and alignment is difficult.  
Especially when installing a fiber with many cores (sharp bending fibers and heat-resistant glass fiber) please be sure to use it only after you have adjusted it sufficiently.  
2) The sensing ranges are the values for red LED type amplifier. Please contact our office for details on sensing ranges for other types of amplifiers.  
3) The fiber cable length practically limits the sensing range to 3.500 mm 137.795 in long (FT-H20W-M1 and FT-H20-M1: 1,600 mm 62.992 in).

### Lens (For reflective type fiber)

Designation	Model No.	Description															
For reflective type fiber	Pinpoint spot lens <b>FX-MR1</b>		Pinpoint spot of $\phi 0.5$ mm $\phi 0.020$ in. Enables detection of minute objects or small marks. • Applicable fibers: <b>FD-WG4, FD-G4</b> • Distance to focal point: $6 \pm 1$ mm $0.236 \pm 0.039$ in • Ambient temperature: - 40 to + 70 °C - 40 to + 158 °F														
	Zoom lens <b>FX-MR2</b>		The spot diameter is adjustable from $\phi 0.7$ mm $\phi 0.028$ in to $\phi 2$ mm $\phi 0.079$ in according to how much the fiber is screwed in. • Applicable fibers: <b>FD-WG4, FD-G4</b> • Ambient temperature: - 40 to + 70 °C - 40 to + 158 °F • Accessory: <b>MS-EX-3</b> (mounting bracket)														
	Finest spot lens <b>FX-MR3</b>		Extremely fine spot of $\phi 0.3$ mm $\phi 0.012$ in approx. achieved. • Applicable fibers: <b>FD-WG4, FD-G4, FD-EG1, FD-EG2, FD-EG3, FD-G6X, FD-G6</b> • Ambient temperature: - 40 to + 70 °C - 40 to + 158 °F														
	Finest spot lens <b>FX-MR6</b>		Extremely fine spot of $\phi 0.1$ mm $\phi 0.004$ in approx. achieved. • Applicable fibers: <b>FD-WG4, FD-G4, FD-EG1, FD-EG2, FD-EG3, FD-G6X, FD-G6</b> • Ambient temperature: - 20 to + 60 °C - 4 to + 140 °F														
	Zoom lens (Side-view type) <b>FX-MR5</b>		<b>FX-MR2</b> is converted into a side-view type and can be mounted in a very small space. • Applicable fibers: <b>FD-WG4, FD-G4</b> • Ambient temperature: - 40 to + 70 °C - 40 to + 158 °F														
		<b>Sensing range (Note 1)</b>															
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FD-EG2	$7 \pm 0.5$ mm	$\phi 0.15$ mm approx.															
FD-EG1	$7 \pm 0.5$ mm	$\phi 0.2$ mm approx.															
FD-WG4/G4/G6X/G6	$7 \pm 0.5$ mm	$\phi 0.4$ mm approx.															
		<b>Sensing range (Note 1)</b>															
		<table border="1"> <thead> <tr> <th>Screw-in depth</th> <th>Distance to focal point</th> <th>Spot diameter</th> </tr> </thead> <tbody> <tr><td>8 mm</td><td>13 mm approx.</td><td><math>\phi 0.5</math> mm</td></tr> <tr><td>10 mm</td><td>15 mm approx.</td><td><math>\phi 0.8</math> mm</td></tr> <tr><td>14 mm</td><td>30 mm approx.</td><td><math>\phi 3.0</math> mm</td></tr> </tbody> </table>	Screw-in depth	Distance to focal point	Spot diameter	8 mm	13 mm approx.	$\phi 0.5$ mm	10 mm	15 mm approx.	$\phi 0.8$ mm	14 mm	30 mm approx.	$\phi 3.0$ mm			
Screw-in depth	Distance to focal point	Spot diameter															
8 mm	13 mm approx.	$\phi 0.5$ mm															
10 mm	15 mm approx.	$\phi 0.8$ mm															
14 mm	30 mm approx.	$\phi 3.0$ mm															

Note: The sensing ranges are the values when used in combination with red LED type amplifier. Please contact our office for details on sensing distances for other types of amplifier.

# FX-301

## FIBER OPTIONS

### Others

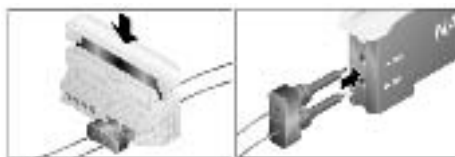
Designation	Model No.	Description		
Protective tube (For thru-beam type fiber)	FTP-500 (0.5 m 1.640 ft)	For M4 thread	FT-B8 FT-N8 FT-NB8 FT-P80 FT-FM2 FT-P60 FT-FM2S FT-H13-FM2 FT-FM2S4	
	FTP-1000 (1 m 3.281 ft)		Applicable fibers	FT-T80 FT-P40 FT-NFM2 FD-T40 FT-NFM2S FD-P40 FT-NFM2S4
	FTP-1500 (1.5 m 4.921 ft)			FD-B8 FD-P80 FD-FM2 FD-H13-FM2 FD-FM2S4 FD-N8
	FTP-N500 (0.5 m 1.640 ft)	FD-T80 FD-N4 FD-NFM2 FD-NFM2S FD-NFM2S4		
	FTP-N1000 (1 m 3.281 ft)	For M3 thread		
	FTP-N1500 (1.5 m 4.921 ft)			
Protective tube (For reflective type fiber)	FDP-500 (0.5 m 1.640 ft)	For M6 thread	FD-B8 FD-P80 FD-FM2 FD-H13-FM2 FD-FM2S4 FD-N8	
	FDP-1000 (1 m 3.281 ft)		Applicable fibers	FD-T80 FD-N4 FD-NFM2 FD-NFM2S FD-NFM2S4
	FDP-1500 (1.5 m 4.921 ft)			FD-B8 FD-P80 FD-FM2 FD-H13-FM2 FD-FM2S4 FD-N8
	FDP-N500 (0.5 m 1.640 ft)	FD-T80 FD-N4 FD-NFM2 FD-NFM2S FD-NFM2S4		
	FDP-N1000 (1 m 3.281 ft)	For M4 thread		
	FDP-N1500 (1.5 m 4.921 ft)			
Fiber bender	FB-1	The fiber bender bends the sleeve part of the fiber head at the proper radius. (Note 1)		
Universal sensor mounting stand (Note 2)	MS-AJ1-F	Horizontal mounting type	Mounting stand assembly for fiber (For M3, M4 or M6 threaded head fiber)	
	MS-AJ2-F	Vertical mounting type		
Fiber cutter	FX-CT2	The free-cut type fiber can be easily cut.		
	FX-CT1	[Accessory. Does not attach with the FT-N8/NB8 or the FD-N8/N4. (Note 3)]		
Attachment for fixed-length fiber	FX-AT2	This is the attachment for the fixed length fiber. (Accessory)		
Attachment for $\phi 2.2$ mm $\phi 0.087$ in fiber	FX-AT3	This is the attachment for the $\phi 2.2$ mm $\phi 0.087$ in fiber. (Accessory. Does not attach with the FT-N8/NB8/P80 or the FD-N8/P80.)		
Attachment for $\phi 1$ mm $\phi 0.039$ in fiber	FX-AT4	This is the attachment for the $\phi 1$ mm $\phi 0.039$ in fiber (Accessory. Does not attach with the FD-N4.) (Note 4)		
Attachment for $\phi 1.3$ mm $\phi 0.051$ in fiber	FX-AT5	This is the attachment for the $\phi 1.3$ mm $\phi 0.051$ in fiber (Accessory)		
Attachment for $\phi 1$ mm $\phi 0.039$ in / $\phi 1.3$ mm $\phi 0.051$ in mixed fiber	FX-AT6	This is the attachment for the $\phi 1$ mm $\phi 0.039$ in / $\phi 1.3$ mm $\phi 0.051$ in mixed fiber. (Accessory)		

- Notes: 1) Do not bend the sleeve part of any side-view type fiber or ultra-small diameter head type fiber.  
 2) Refer to p.332~ for details of the universal sensor mounting stand.  
 3) A conventional FX-CT1 fiber cutter is attached with the FT-P80 and the FD-P80.  
 4) The conventional FX-AT10 fiber attachment is attached with the FD-N4.

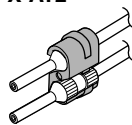
### Fiber attachment

#### It's possible to simultaneously cut two fibers to the same length

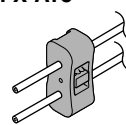
Each fiber (with some exceptions) has a newly developed two-in-one fiber attachment (FX-AT3/AT4/AT5/AT6) which enables two fibers to be cut simultaneously to the same length with the new fiber cutter (FX-CT2). Also, since the fibers can be attached to the amplifier while being fixed in position in the two-in-one fiber attachment, sensitivity changes resulting from variation in the amount of fiber insertion do not occur.



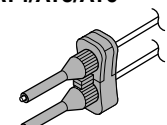
FX-AT2



FX-AT3

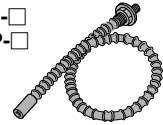


FX-AT4/AT5/AT6



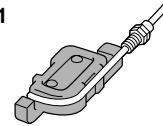
### Protective tube

- FTP-□
- FDP-□



### Fiber bender

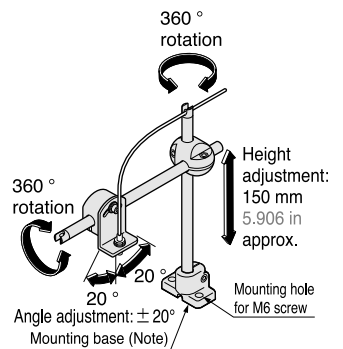
- FB-1



### Universal sensor mounting stand

- MS-AJ1-F
- MS-AJ2-F

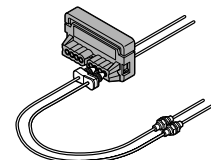
Using the arm which enables adjustment in the horizontal direction, sensing can also be done from above an assembly line.



Note: The above figure is MS-AJ1-F. The mounting base of MS-AJ2-F has a different shape.

### Fiber cutter

- FX-CT2



- FX-CT1



## SPECIFICATIONS

### Amplifiers

Item	Type Model No.	NPN output				PNP output			
		Red LED	Blue LED	Green LED	Infrared LED	Red LED	Blue LED	Green LED	Infrared LED
Supply voltage		12 to 24 V DC $\pm$ 10 % Ripple P-P 10 % or less							
Power consumption		<Red LED / Infrared LED type> Normal operation: 960 mW or less (Current consumption 40 mA or less at 24 V supply voltage) ECO mode: 600 mW or less (Current consumption 25 mA or less at 24 V supply voltage)				<Blue LED / Green LED type> Normal operation: 720 mW or less (Current consumption 30 mA or less at 24 V supply voltage) ECO mode: 430 mW or less (Current consumption 18 mA or less at 24 V supply voltage)			
Output		NPN open-collector transistor • Maximum sink current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less (at 100 mA (at 50 mA, if five, or more, amplifiers are connected in cascade) sink current.)				PNP open-collector transistor • Maximum source current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) • Applied voltage: 30 V DC or less (between output and + V) • Residual voltage: 1.5 V or less (at 100 mA (at 50 mA, if five, or more, amplifiers are connected in cascade) source current.)			
	Utilization category	DC-12 or DC-13							
	Output operation	Selectable either Light-ON or Dark-ON, with jog switch							
	Short-circuit protection	Incorporated							
Response time		65 $\mu$ s or less (ultra high speed), 150 $\mu$ s or less (FAST), 250 $\mu$ s or less [STD / S-D (Red LED type only)], 2 ms or less (LONG) selectable with jog switch							
Sensitivity setting		2-level teaching / Limit teaching / Manual adjustment / Full auto-teaching (excluding red LED type)							
Operation indicator		Orange LED (lights up when the output is ON)							
Stability indicator		Green LED (lights up under stable light received condition or stable dark condition)							
MODE indicator		RUN: Green LED, TEACH · ADJ · L/D ON · TIMER · PRO: Yellow LED							
Digital display		4 digit red LED display							
Fine sensitivity adjustment function		Incorporated							
Timer function		Incorporated with variable ON-delay / OFF-delay / ONE SHOT timer, switchable either effective or ineffective. (timer period: 0.5 to 500 ms approx.)							
Automatic interference prevention function		Incorporated (Up to four sets of fiber heads can be mounted close together) (Note 1)							
Environmental resistance	Pollution degree	3 (Industrial environment)							
	Ambient temperature	- 10 to + 55 °C + 14 to + 131 °F (If 4 to 7 units are connected in cascade: - 10 to + 50 °C + 14 to + 122 °F, if 8 to 16 units are connected in cascade: - 10 to + 45 °C + 14 to + 113 °F) (No dew condensation or icing allowed), Storage: - 20 to + 70 °C - 4 to + 158 °F							
	Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH							
	Ambient illuminance	Sunlight: 10,000 $\ell$ x at the light-receiving face, Incandescent light: 3,000 $\ell$ x at the light-receiving face							
	EMC	Red LED type: EN 50081-2, EN 50082-2, EN 60947-5-2 Blue / green / infrared LED type: EN 60947-5-2							
	Voltage withstandability	1,000 V AC for one min. between all supply terminals connected together and enclosure (Note 2)							
	Insulation resistance	20 M $\Omega$ , or more, with 250 V DC megger between all supply terminals connected together and enclosure (Note 2)							
	Vibration resistance	10 to 150 Hz frequency, 0.75 mm 0.030 in amplitude in X, Y and Z directions for two hours each							
Shock resistance	98 m/s <sup>2</sup> acceleration (10 G approx.) in X, Y and Z directions for five times each								
Emitting element (modulated)		Red LED	Blue LED	Green LED	Infrared LED	Red LED	Blue LED	Green LED	Infrared LED
Material		Enclosure: Heat-resistant ABS, Case cover: Polycarbonate, Switch: Acrylic							
Connecting method		Connector (Note 3)							
Cable extension		Extension up to total 100 m 328.084 ft is possible with 0.3 mm <sup>2</sup> , or more, cable.							
Weight		25 g approx.							

- Notes: 1) When the power supply is switched on, the emission timing are automatically set for interference prevention.  
 2) The voltage withstandability and the insulation resistance values given in the above table are for the amplifier only.  
 3) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cable given below.  
 Main cable (3-core): **CN-73-C1** (cable length 1 m 3.281 ft), **CN-73-C2** (cable length 2 m 6.562 ft), **CN-73-C5** (cable length 5 m 16.404 ft)  
 Sub cable (1-core): **CN-71-C1** (cable length 1 m 3.281 ft), **CN-71-C2** (cable length 2 m 6.562 ft), **CN-71-C5** (cable length 5 m 16.404 ft)



# FX-301

## SPECIFICATIONS

### Fibers

Item	Type	Standard	Flexible
Allowable bending radius		R25 mm R0.984 in or more [Sleeve of a head with sleeve: R10 mm R0.394 in or more (Note 1)]	R4 mm R0.157 in or more
Bending durability			1 million times or more (at R10 mm R0.394 in, <b>FT-P40/P2</b> and <b>FD-P40/P2</b> : at R4 mm R0.157 in)
Ambient temperature		$-40$ to $+70$ °C $-40$ to $+158$ °F <b>FT-SFM2SV2</b> : $-20$ to $+70$ °C $-4$ to $+158$ °F <b>FT-V22, FD-SFM2SV2</b> : $-20$ to $+60$ °C $-4$ to $+140$ °F <b>FT-V41, FD-V41, FT-V10</b> : $-40$ to $+60$ °C $-40$ to $+140$ °F	$-40$ to $+70$ °C $-40$ to $+158$ °F <b>(FT-Z8□, FT-P60, FT-PS1, FD-P60, FD-P50:)</b> $-40$ to $+60$ °C $-40$ to $+140$ °F
Ambient humidity		35 to 85%RH (No dew condensation or icing allowed)	
Material	Fiber core	Acrylic	
	Sheath	Polyethylene ( <b>FT-V22</b> : Polyolefin)	Vinyl chloride ( <b>FT-PS1</b> : Polyethylene, <b>FD-P2</b> : Vinyl chloride and Polyurethane)
	Fiber head	Brass (Nickel plated) <b>(FT-SFM2L/T80/SFM2/SNFM2/SFM2SV2/V22/V41, FD-T80/T40/S80/SNFM2/SFM2SV2/V41 and Sleeve: Stainless steel (SUS) FT-FM10L: ABS, Lens of FT-FM10L/SFM2L/V10: Acrylic FT-V10: Stainless steel (SUS) and Polycarbonate</b>	Stainless steel (SUS) <b>(FT/FD-P80, FT-P60: Brass (Nickel plated) Case of FT-Z8□: Polycarbonate Lens of FT-Z8H/Z8E, Front film of FT-Z8: Polyester)</b>
Accessories (Note 2)	All fibers (except for <b>FT-NB8/N8</b> and <b>FD-N8/N4</b> ): 1 fiber attachment set Free-cut type fibers (except for <b>FT-NB8/N8</b> and <b>FD-N8/N4</b> ): <b>FX-CT2</b> (fiber cutter) 1 pc. Threaded head fibers: Nuts 2 pcs. (thru-beam type: 4 pcs.) and toothed lock washer 1 pc. (thru-beam type: 2 pcs.)		

Notes: 1) Sleeve part of side-view fiber cannot be bent.

2) The five types of attached fiber attachments (**FX-AT2/AT3/AT4/AT5/AT6**) described in this catalog are for use only with the **FX-301/311** series. Refer to p.82 for details 'FIBER OPTIONS'. Fiber attachment accessories are also supplied along with conventional amplifiers. Please contact our office for more details on these accessories.

Item	Type	Sharp bending
Allowable bending radius		R1 mm R0.039 in or more ( <b>FD-WG4/WG4</b> : R2 mm R0.079 in or more, Sleeve of <b>FD-W44</b> : R10 mm R0.394 in or more)
Ambient temperature		$-40$ to $+60$ °C $-40$ to $+140$ °F ( <b>FT-WA30/WA8/WKV8</b> : $-40$ to $+55$ °C $-40$ to $+131$ °F)
Ambient humidity		35 to 85 %RH (No dew condensation or icing allowed)
Material	Fiber core	Acrylic
	Sheath	Polyethylene
	Fiber head	Stainless steel (SUS) (including sleeve) <b>(FT-W8/W4, FD-W8/W44/WG4: Brass (Nickel plated) Case of FT-WA30/WA8/WZ8□, Lens of FT-WS8L and Resin part of FT-WKV8: Polycarbonate, Lens of FT-WA30: Norbornene resin Lens of FT-WA8: Polyolefin, Lens of FT-WZ8H/WZ8E, Reflector of FT-WZ8E and Prism of FT-WKV8: Acrylic, Reflector of FT-WZ8: Polycarbonate, FD-WL41: Heat-resistant ABS, Front film of FD-WL41: Polyester, FD-WL42: Aluminum (Black ALMITE), Lens of FD-WKZ1: Optical lens</b>
Accessories (Note)	All fibers: 1 fiber attachment set and <b>FX-CT2</b> (fiber cutter) 1 pc. Threaded fibers: Nuts 2 pcs. (thru-beam type: 4 pcs.) and toothed lock washer 1 pc. (thru-beam type: 2 pcs.) <b>FT-WA30</b> : 0.5 × 32 mm 0.020 × 1.260 in seal type slit mask 2 pcs. <b>FT-WA8</b> : 0.5 × 12 mm 0.020 × 0.472 in seal type slit mask 2 pcs. and 1 × 12 mm 0.039 × 0.472 in seal type slit mask 2 pcs. <b>FT-WZ8□</b> : 1 set of mounting screw <b>FD-WKZ1</b> : mounting bracket 1 pc.	

Note: The five types of attached fiber attachments (**FX-AT2/AT3/AT4/AT5/AT6**) described in this catalog are for use only with the **FX-301/311** series. Refer to p.82 for details 'FIBER OPTIONS'. Fiber attachment accessories are also supplied along with conventional amplifiers. Please contact our office for more details on these accessories.

Item	Type	Special use			
		Wide beam	Array	Narrow beam	High precision
Allowable bending radius		<b>FT-A30/A8</b> : R10 mm R0.394 in or more <b>FD-A15</b> : R25 mm R0.984 in or more	R25 mm R0.984 in or more	R25 mm R0.984 in or more <b>(FT-KV1: R10 mm R0.394 in or more)</b>	<b>FD-EG2/EG3</b> : R10 mm R0.394 in or more <b>FD-G4/G6/EG1</b> : R25 mm R0.984 in or more
Ambient temperature		<b>FT-A30, FD-A15</b> : $-40$ to $+60$ °C $-40$ to $+140$ °F <b>FT-A8</b> : $-40$ to $+70$ °C $-40$ to $+158$ °F	$-40$ to $+70$ °C $-40$ to $+158$ °F	$-40$ to $+60$ °C $-40$ to $+140$ °F	$-20$ to $+60$ °C $-4$ to $+140$ °F <b>(FD-G4: <math>-40</math> to <math>+70</math> °C <math>-40</math> to <math>+158</math> °F)</b> <b>(FD-G6: <math>-40</math> to <math>+60</math> °C <math>-40</math> to <math>+140</math> °F)</b>
Ambient humidity		35 to 85 %RH (No dew condensation or icing allowed)			
Material	Fiber core	Acrylic			
	Sheath	Polyethylene			Polyolefin ( <b>FD-G4/G6</b> : Polyethylene)
	Fiber head	Polycarbonate (Lens of <b>FT-A30, FD-A15</b> : Norbornene resin) Lens of <b>FT-A8</b> : Polyolefin	Brass (Nickel plated)	Stainless steel (SUS), Polycarbonate (Lens: Norbornene resin Lens of <b>FT-KV1</b> : Polycarbonate, Prism of <b>FT-KV8</b> : Acrylic)	Brass (Nickel plated) <b>(FD-G6: Stainless steel (SUS))</b>
Accessories (Note)	All fibers: 1 fiber attachment set and <b>FX-CT2</b> (fiber cutter) 1 pc. <b>FT-A30</b> : 0.5 × 32 mm 0.020 × 1.260 in seal type slit mask 2 pcs. <b>FT-A8</b> : 0.5 × 12 mm 0.020 × 0.472 in seal type slit mask 2 pcs. and 1 × 12 mm 0.039 × 0.472 in seal type slit mask 2 pcs.		All fibers: 1 fiber attachment set Free-cut type fibers: <b>FX-CT2</b> (fiber cutter) 1 pc. Threaded head fibers: Nuts 2 pcs. and toothed lock washer 1 pc.		

Note: The five types of attached fiber attachments (**FX-AT2/AT3/AT4/AT5/AT6**) described in this catalog are for use only with the **FX-301/311** series. Refer to p.82 for details 'FIBER OPTIONS'. Fiber attachment accessories are also supplied along with conventional amplifiers. Please contact our office for more details on these accessories.

## SPECIFICATIONS

### Fibers

Item \ Type		Special use		
		Ultra-small diameter	Fixed-focus reflective	Tough flexible
Allowable bending radius		FT-E12/E22: R5 mm R0.197 in or more (Note 1) FD-E12: R10 mm R0.394 in or more (Note 1) FD-E22/EN500S1/ENM1S1: R25 mm R0.984 in or more (Note 1)	R10 mm R0.394 in or more (FD-L43: R4 mm R0.157 in or more)	R10 mm R0.394 in or more
Ambient temperature		FT-E12/E22, FD-E22: -40 to +70 °C -40 to +158 °F FD-E12: -40 to +60 °C -40 to +140 °F FD-EN500S1/ENM1S1: -20 to +60 °C -4 to +140 °F	FD-L43: 0 to +70 °C +32 to +158 °F FD-L41/L42: -40 to +60 °C -40 to +140 °F FD-L4: -40 to +70 °C -40 to +158 °F	-40 to +60 °C -40 to +140 °F (FD-P81X: -40 to +70 °C -40 to +158 °F)
Ambient humidity		35 to 85 %RH (No dew condensation or icing allowed)		
Material	Fiber core	Acrylic		
	Sheath	Polyolefin	Polyethylene (FD-L42: Vinyl chloride)	Polyethylene [FT-P81X: Vinyl chloride, Protective tube: Stainless steel (SUS)]
	Fiber head	Brass (Nickel plated) [Sleeve: Stainless steel (SUS)]	FD-L43/L41: Heat-resistant ABS FD-L4: ABS FD-L42: Aluminum (Black ALMITE) (Lens of FD-L43/L4: Acrylic (Front film of FD-L41: Polyester)	FT-P81X, FD-P81X: Brass (Nickel plated) FD-G6X: Stainless steel (SUS)
Accessories (Note 2)		All fibers: 1 fiber attachment set Threaded head fibers: Nuts 2 pcs. and toothed lock washer 1 pc.	All fibers: 1 fiber attachment set and FX-CT2 (fiber cutter) 1 pc. FD-L4: M2.6 (length 12 mm 0.472 in) screws with washers 2 pcs. and nuts 2 pcs.	All fibers: 1 fiber attachment set, nuts 2 pcs. (thru-beam type: 4 pcs.) and toothed lock washer 1 pc. (thru-beam type: 2 pcs.) FD-G6X: FX-CT2 (fiber cutter) 1 pc.

Notes: 1) Sleeve part cannot be bent.

2) The five types of attached fiber attachments (FX-AT2/AT3/AT4/AT5/AT6) described in this catalog are for use only with the FX-301/311 series. Refer to p.82 for details 'FIBER OPTIONS'. Fiber attachment accessories are also supplied along with conventional amplifiers. Please contact our office for more details on these accessories.

Item \ Type		Special use	
		Liquid level sensing	
Model No.		FD-F8Y	FD-F4□/F9□
Allowable bending radius		Protective tube: R40 mm R1.575 in or more Fiber: R15 mm R0.591 in or more	R10 mm R0.394 in or more
Ambient temperature		-40 to +125 °C -40 to +257 °F (Note 1)	-40 to +100 °C -40 to +212 °F (Note 1)
Ambient humidity		35 to 85 %RH (No dew condensation or icing allowed)	
Material	Fiber core	Polycarbonate	
	Sheath	Polypropylene (Protective tube: Fluorine resin)	Polyethylene
	Fiber head		Polyetherimide (Lens: Polycarbonate)
Accessories (Note 2)		1 fiber attachment set FX-CT2 (fiber cutter) 1 pc.	1 fiber attachment set, FX-CT2 (fiber cutter) 1pc. Tying bands 4 pcs., anti-slip tubes 2 pcs.

Notes: 1) With the liquid sensing fiber, make sure that the temperature of the liquid is also within the ambient temperature range.

2) The five types of attached fiber attachments (FX-AT2/AT3/AT4/AT5/AT6) described in this catalog are for use only with the FX-301/311 series. Refer to p.82 for details 'FIBER OPTIONS'. Fiber attachment accessories are also supplied along with conventional amplifiers. Please contact our office for more details on these accessories.

Item \ Type		Environment resistant					Chemical-resistant	Vacuum
		Heat-resistant						
		350 °C 662 °F type	300 °C 572 °F type	200 °C 392 °F type	180 °C 356 °F type	130 °C 266 °F type		
Allowable bending radius		R25 mm R0.984 in or more (FT-H20W-□): R10 mm R0.394 in or more, Sleeve of a head with sleeve: R10 mm R0.394 in or more)					R30 mm R1.181 in or more (FT-Z802Y: R25 mm R0.984 in or more)	R200 mm R7.874 in or more (FT-60V: R30 mm R1.181 in or more)
Ambient temperature		-60 to +350 °C -76 to +662 °F (Note 1, 2)	-60 to +300 °C -76 to +572 °F (Note 1, 2, 3)	-60 to +200 °C -76 to +392 °F (Note 2)	-60 to +180 °C -76 to +356 °F (Note 2, 4)	-60 to +130 °C -76 to +266 °F	-40 to +115 °C -40 to +239 °F (FT-Z802Y: 0 to +60 °C +14 to +140 °F)	-40 to +120 °C -40 to +248 °F
Ambient humidity		35 to 85 %RH (No dew condensation or icing allowed)						
Material	Fiber core	Multi-component glass (Note 3)			Silicone	Acrylic		Quartz glass (Note 3)
	Sheath	Stainless steel (SUS)			Silicone (Inside stainless steel (SUS) spiral tube FD-H20-21: Stainless steel (sus) FT-H20W-□: Fluorine resin)	Fluorine resin		Fluorine resin
	Fiber head							
Accessories (Note 5)		FT-H20W-□, FD-H18-L31 and FT-H13-FM2: 1 fiber attachment set Free-cut type fibers: FX-CT2 (fiber cutter) 1 pc. Threaded head fibers: Nuts 2 pcs. (thru-beam type: 4 pcs.) and toothed lock washer 1 pc. (thru-beam type: 2 pcs.)					1 fiber attachment set FX-CT2 (fiber cutter) 1 pc.	Nuts 2 pcs. (thru-beam type: 4 pcs.) and toothed lock washer 1 pc. (thru-beam type: 2 pcs.)

Notes: 1) If the fiber is used below -30 °C -22 °F, its maximum resistable temperature drops to +200 °C +392 °F. If the side-view lens FX-SV1 is put on the fiber head, the allowable maximum temperature drops to +300 °C +572 °F. (The ambient temperature range of FX-SV1 is from -60 to +300 °C -76 to +572 °F.)

2) The ambient temperature of heat-resistant 350 °C 662 °F type, 300 °C 572 °F type, 200 °C 392 °F type and 180 °C 356 °F type fibers are the value in dry condition. In humid environment, the ambient temperature differs. (For a high humidity of 85 %RH, the ambient temperature is 0 to +40 °C +14 to 104 °F.)

3) If the fiber material is quartz glass or multi-component glass, keep it away from vibration or impact.

4) The normal temperature for continuous usage or storage should be -60 to +150 °C -76 to +302 °F.

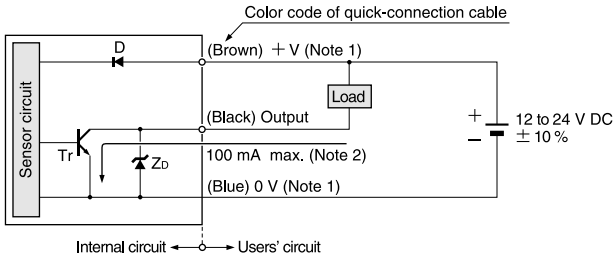
5) The five types of attached fiber attachments (FX-AT2/AT3/AT4/AT5/AT6) described in this catalog are for use only with the FX-301/311 series. Refer to p.82 for details 'FIBER OPTIONS'. Fiber attachment accessories are also supplied along with conventional amplifiers. Please contact our office for more details on these accessories.

# FX-301

## I/O CIRCUIT AND WIRING DIAGRAMS

### NPN output type

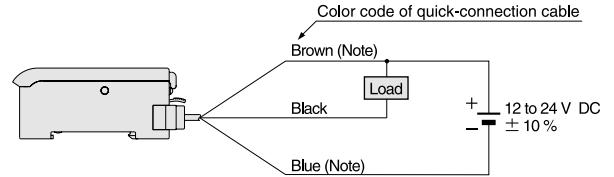
#### I/O circuit diagram



Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue).  
2) 50 mA max., if five amplifiers, or more, are connected together.

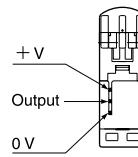
Symbols ... D : Reverse supply polarity protection diode  
Zd: Surge absorption zener diode  
Tr : NPN output transistor

#### Wiring diagram



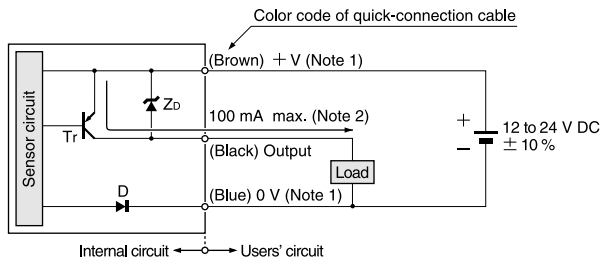
Note: The quick-connection sub cable does not have brown lead wire and blue lead wire.

#### Terminal arrangement diagram



### PNP output type

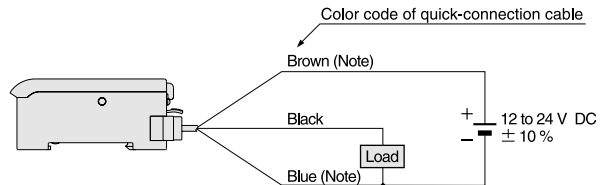
#### I/O circuit diagram



Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue).  
2) 50 mA max., if five amplifiers, or more, are connected together.

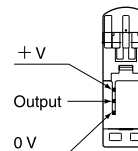
Symbols ... D : Reverse supply polarity protection diode  
Zd: Surge absorption zener diode  
Tr : PNP output transistor

#### Wiring diagram



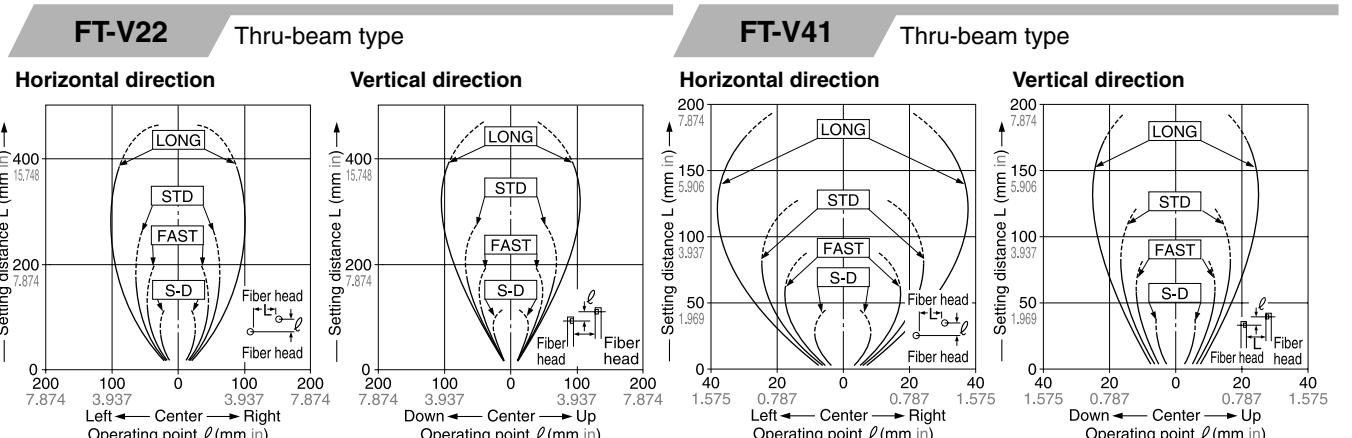
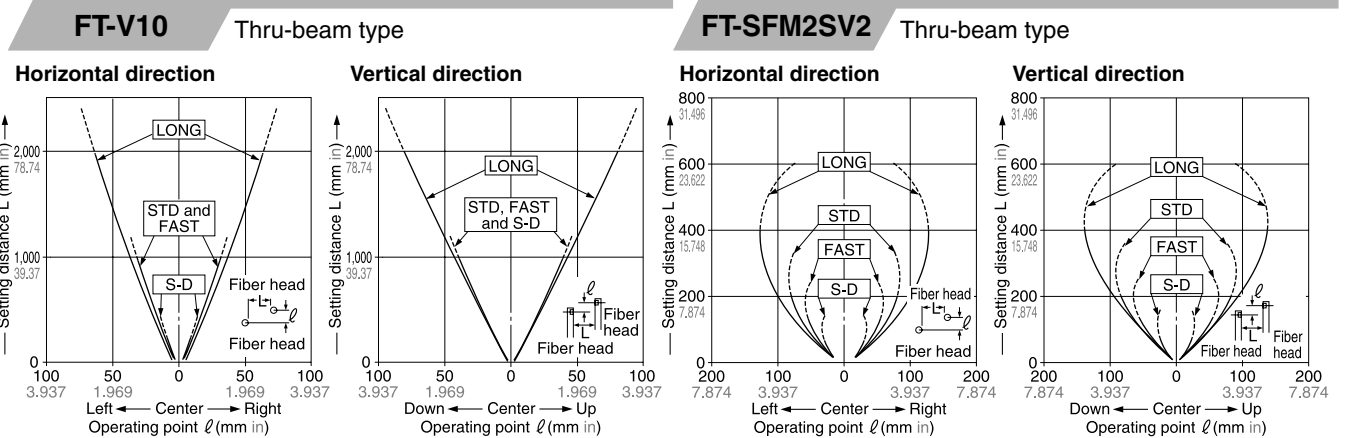
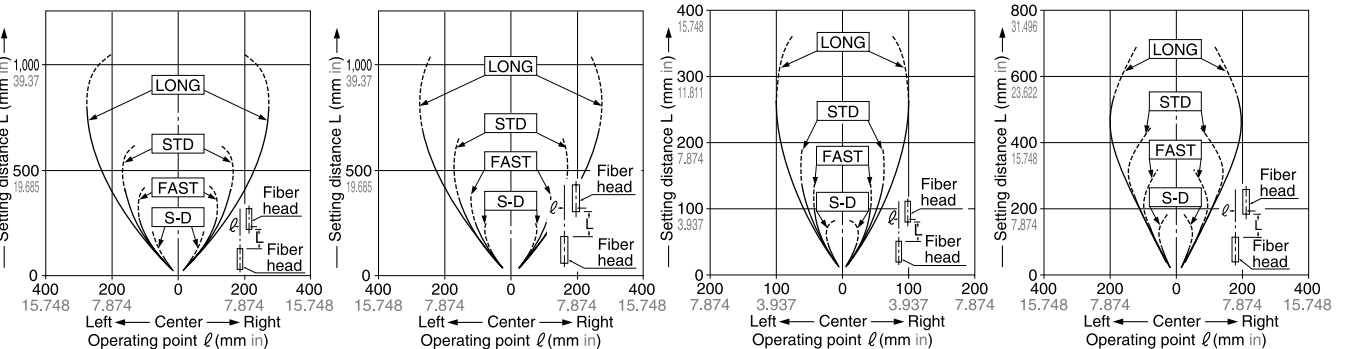
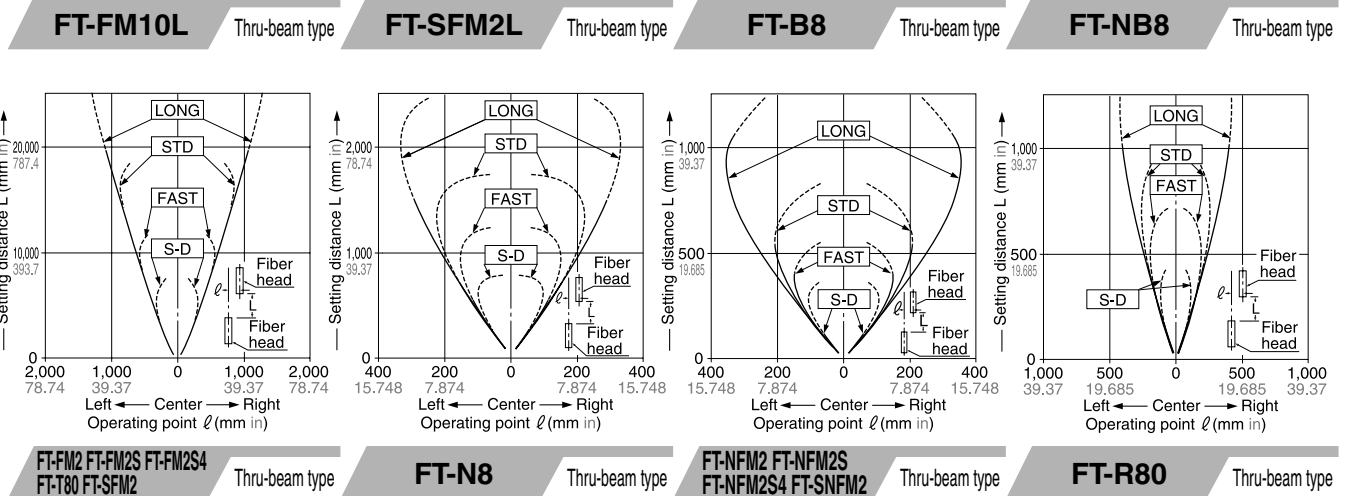
Note: The quick-connection sub cable does not have brown lead wire and blue lead wire.

#### Terminal arrangement diagram



## SENSING CHARACTERISTICS (TYPICAL)

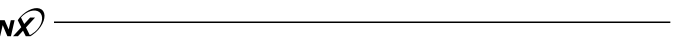
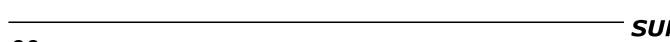
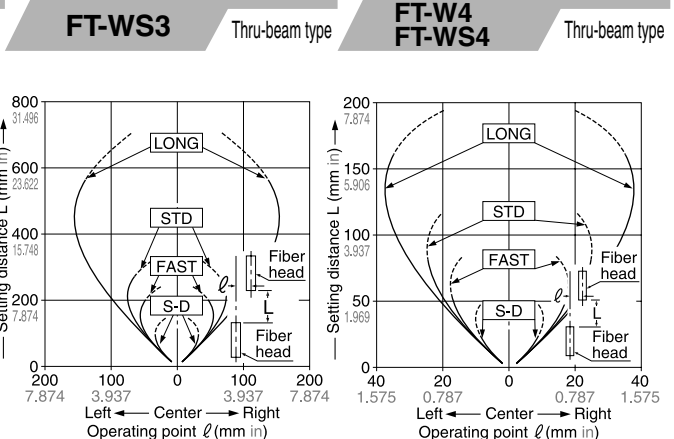
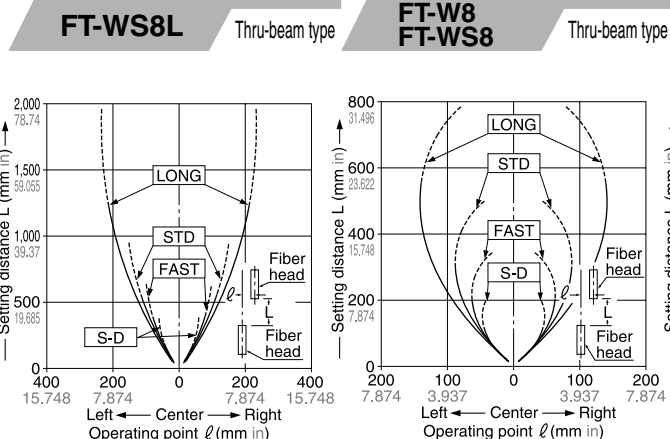
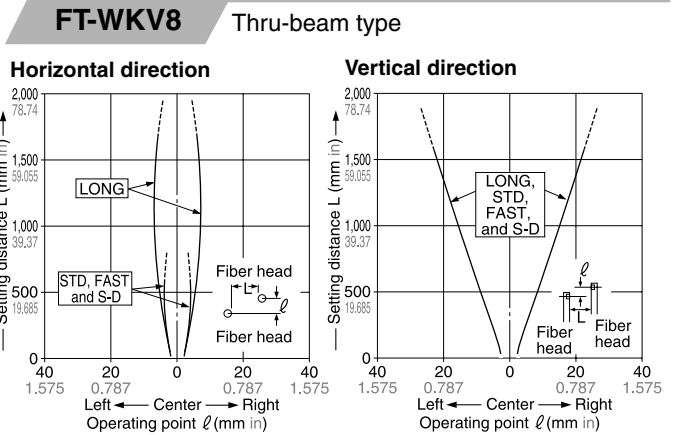
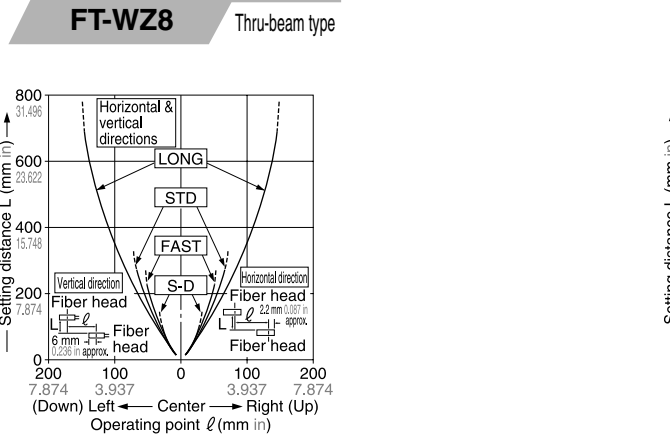
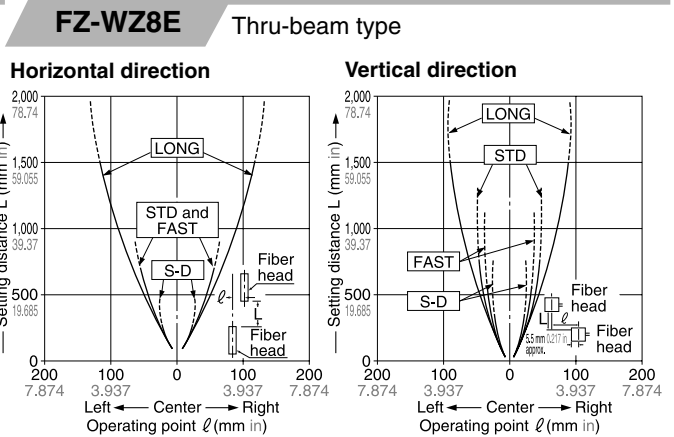
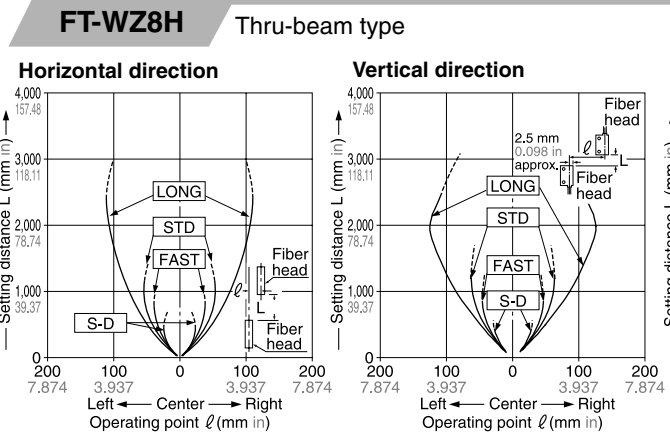
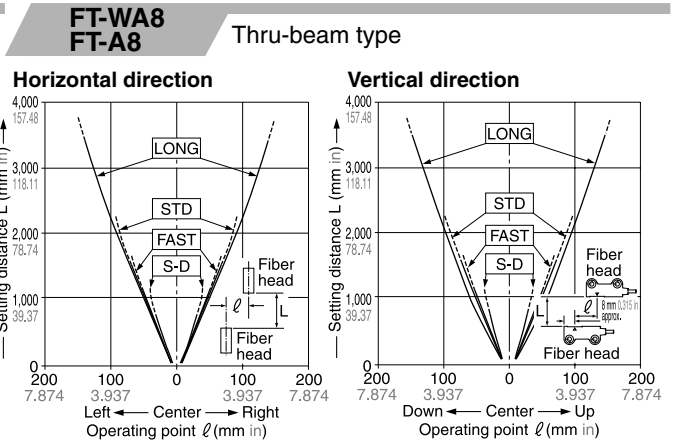
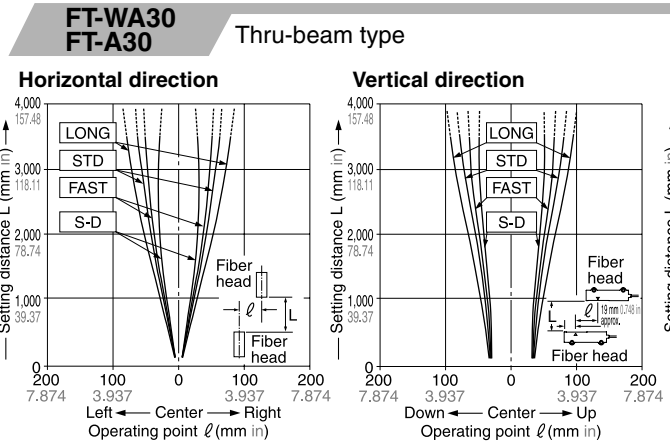
### Parallel deviation



# FX-301

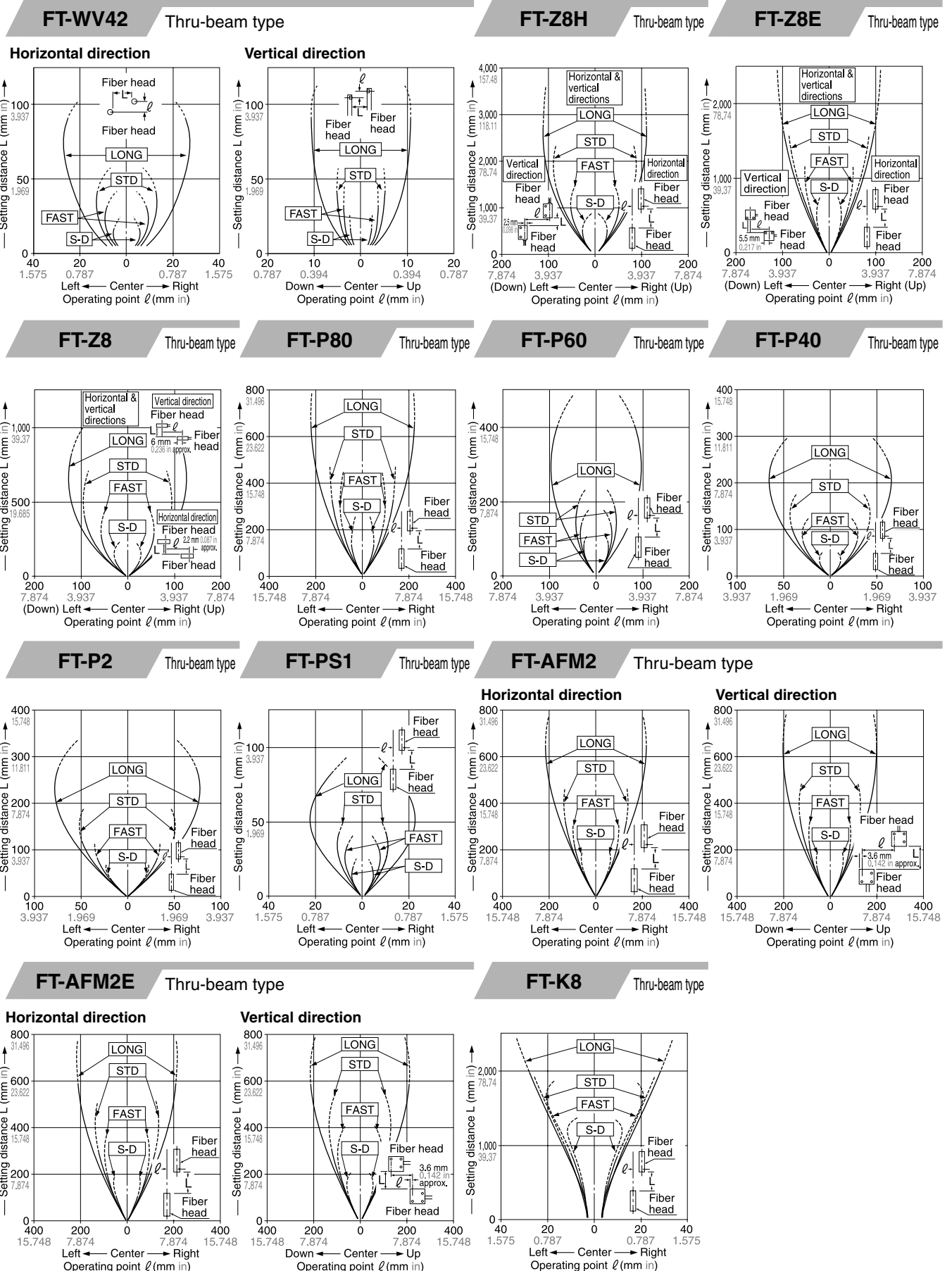
## SENSING CHARACTERISTICS (TYPICAL)

### Parallel deviation



## SENSING CHARACTERISTICS (TYPICAL)

### Parallel deviation



# FX-301

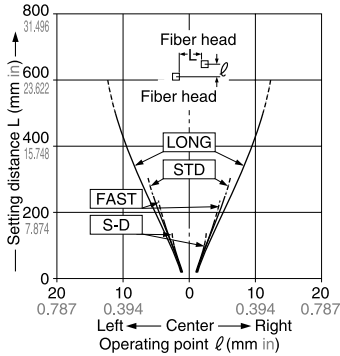
## SENSING CHARACTERISTICS (TYPICAL)

### Parallel deviation

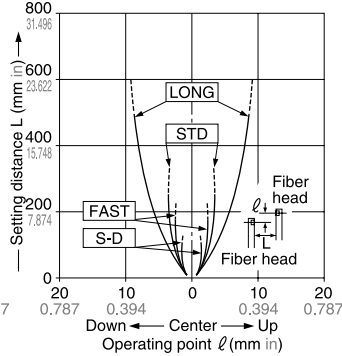
#### FT-KV1

Thru-beam type

#### Horizontal direction



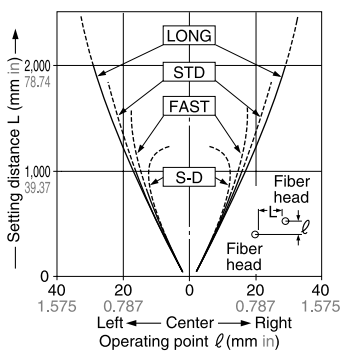
#### Vertical direction



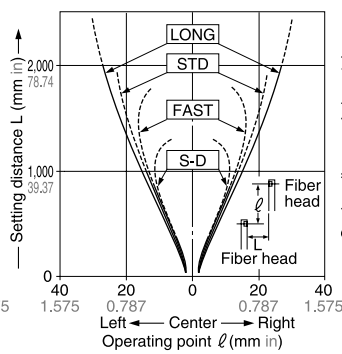
#### FT-KV8

Thru-beam type

#### Horizontal direction

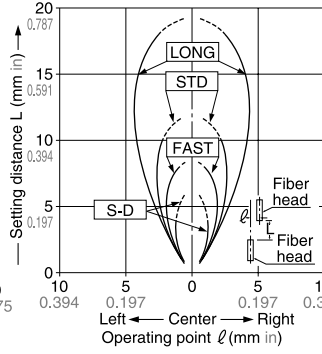


#### Vertical direction



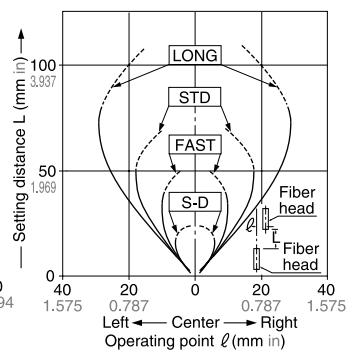
#### FT-E12

Thru-beam type



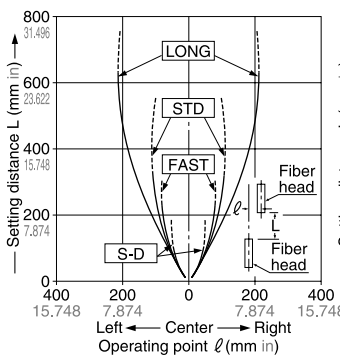
#### FT-E22

Thru-beam type



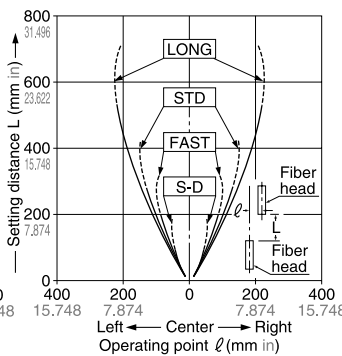
#### FT-P81X

Thru-beam type



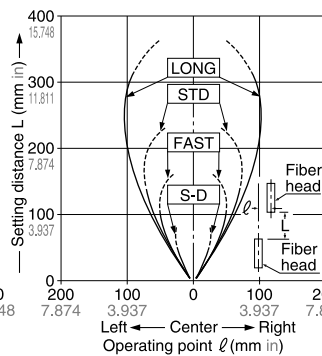
#### FT-H35-M2 FT-H35-M2S6

Thru-beam type



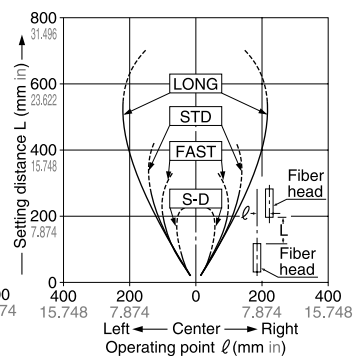
#### FT-H20W-M1 FT-H20W-M2

Thru-beam type



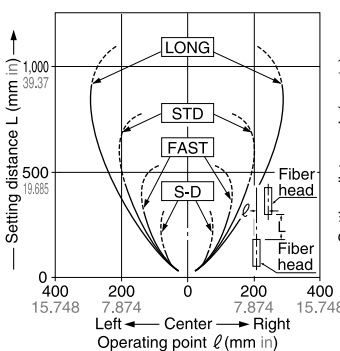
#### FT-H20-M1

Thru-beam type



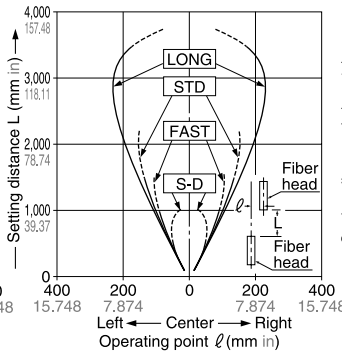
#### FT-H13-FM2

Thru-beam type



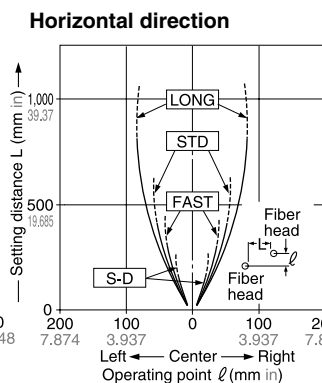
#### FT-L8Y

Thru-beam type

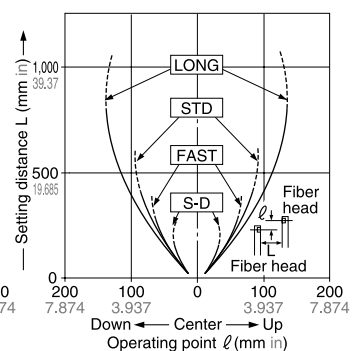


#### FT-V8Y

Thru-beam type

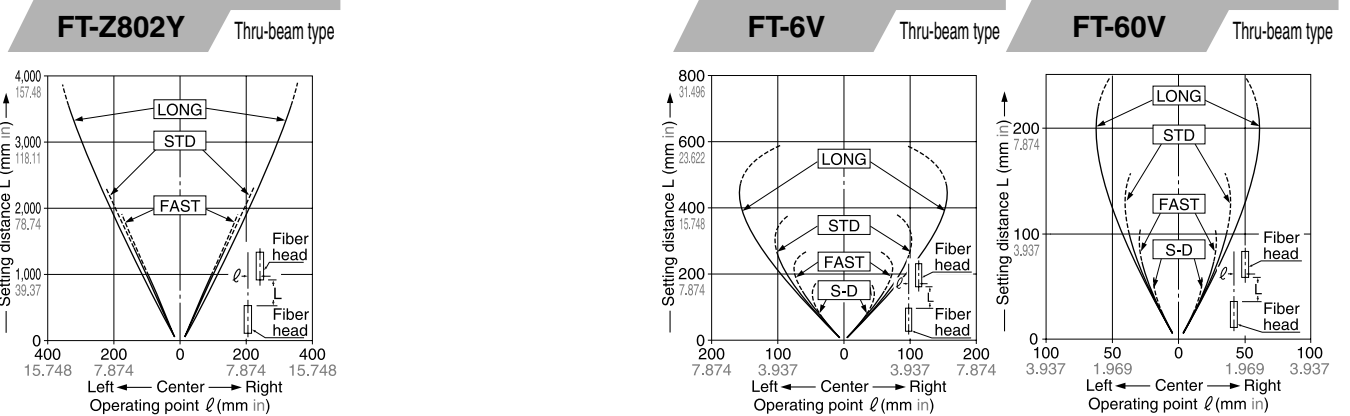


#### Vertical direction

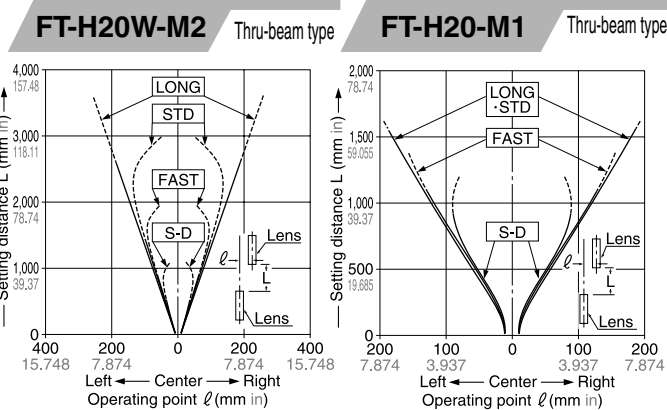
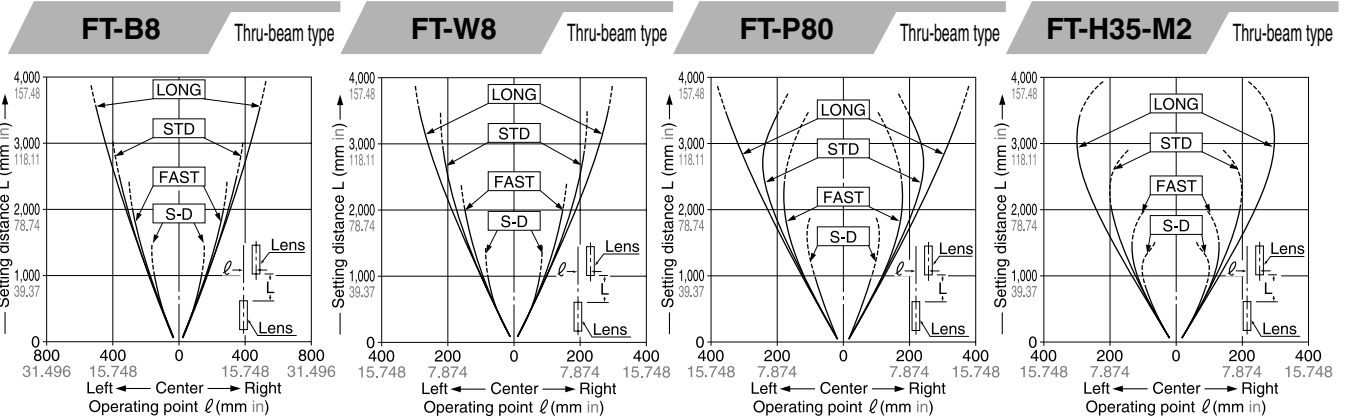


## SENSING CHARACTERISTICS (TYPICAL)

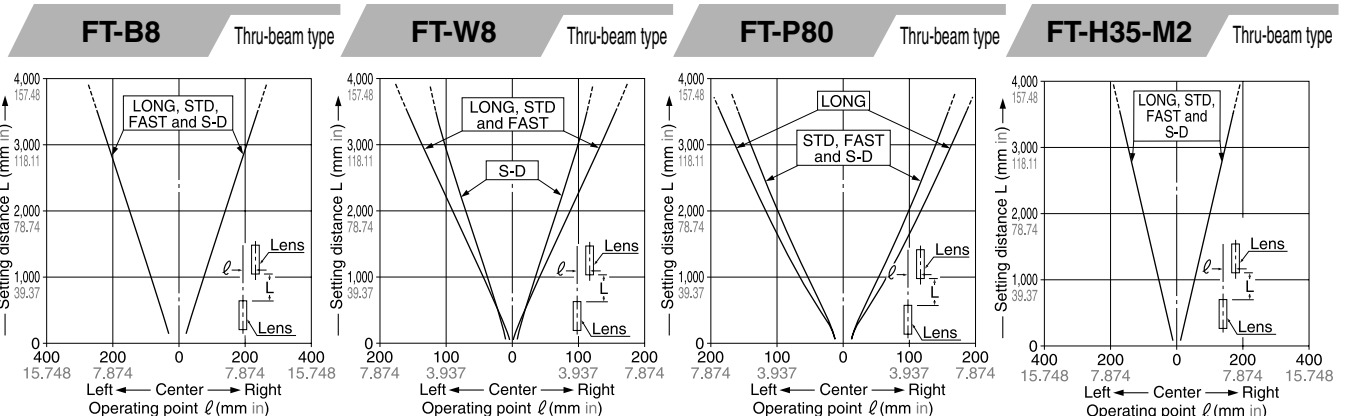
### Parallel deviation



### Parallel deviation with FX-LE1 (expansion lens) applied on both sides



### Parallel deviation with FX-LE2 (super-expansion lens) applied on both sides



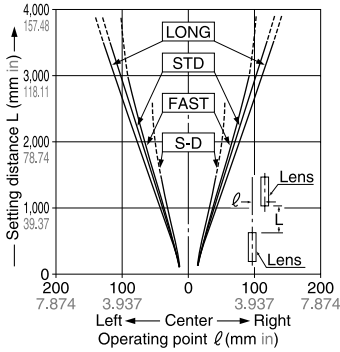


# FX-301

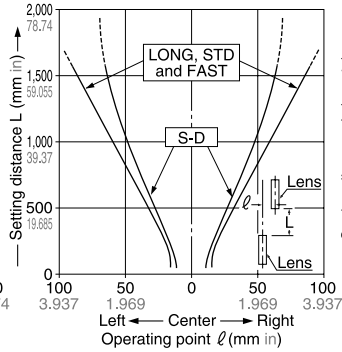
## SENSING CHARACTERISTICS (TYPICAL)

Parallel deviation with FX-LE2 (super-expansion lens) applied on both sides

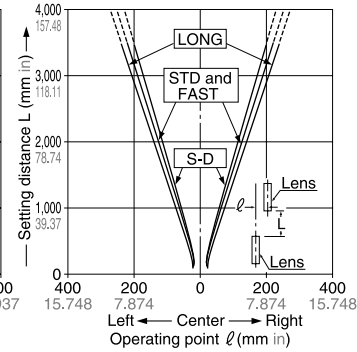
**FT-H20W-M2** Thru-beam type



**FT-H20-M1** Thru-beam type

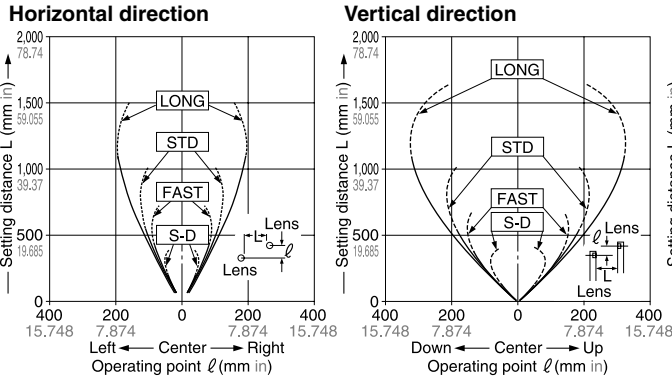


**FT-H13-FM2** Thru-beam type

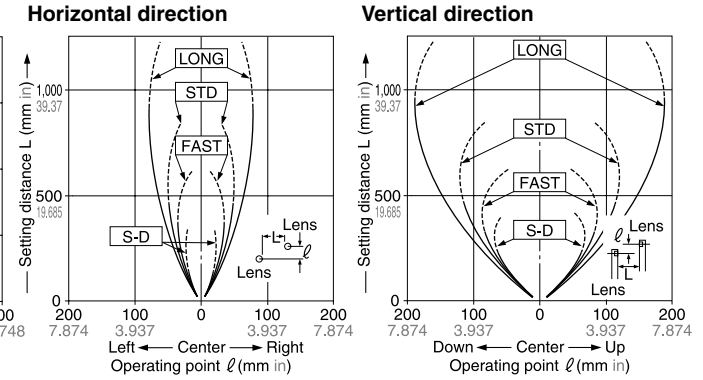


Parallel deviation with FX-SV1 (side-view lens) applied on both sides

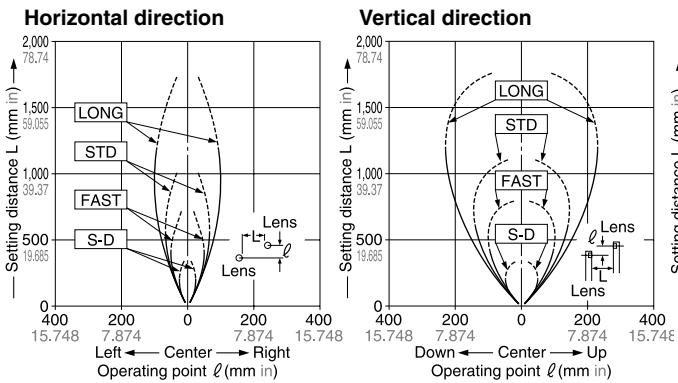
**FT-B8** Thru-beam type



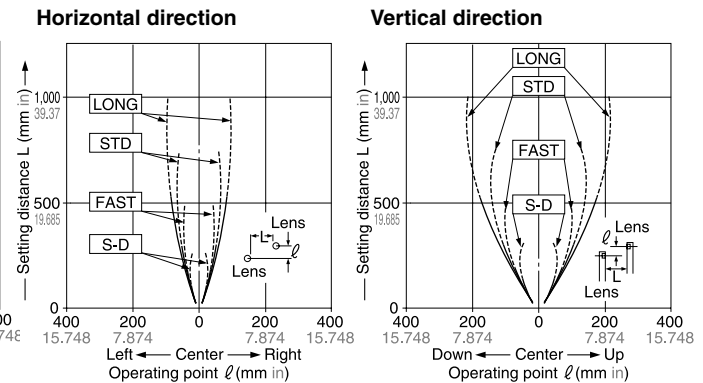
**FT-W8** Thru-beam type



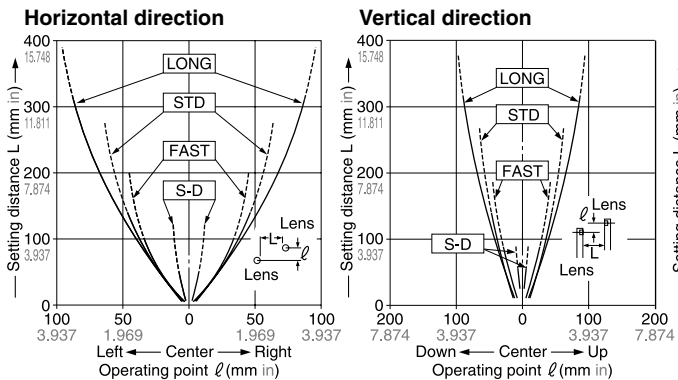
**FT-P80** Thru-beam type



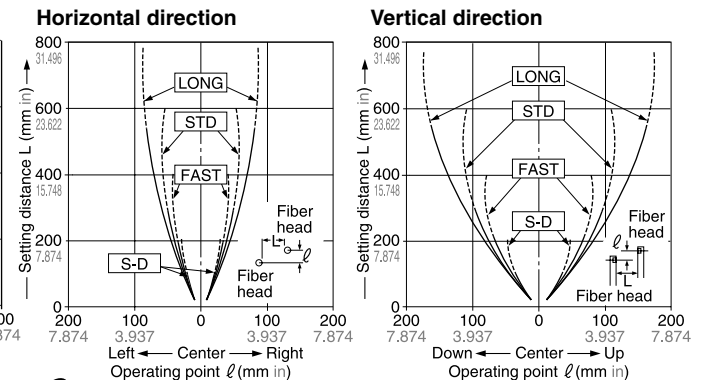
**FT-H35-M2** Thru-beam type



**FT-H20W-M2** Thru-beam type

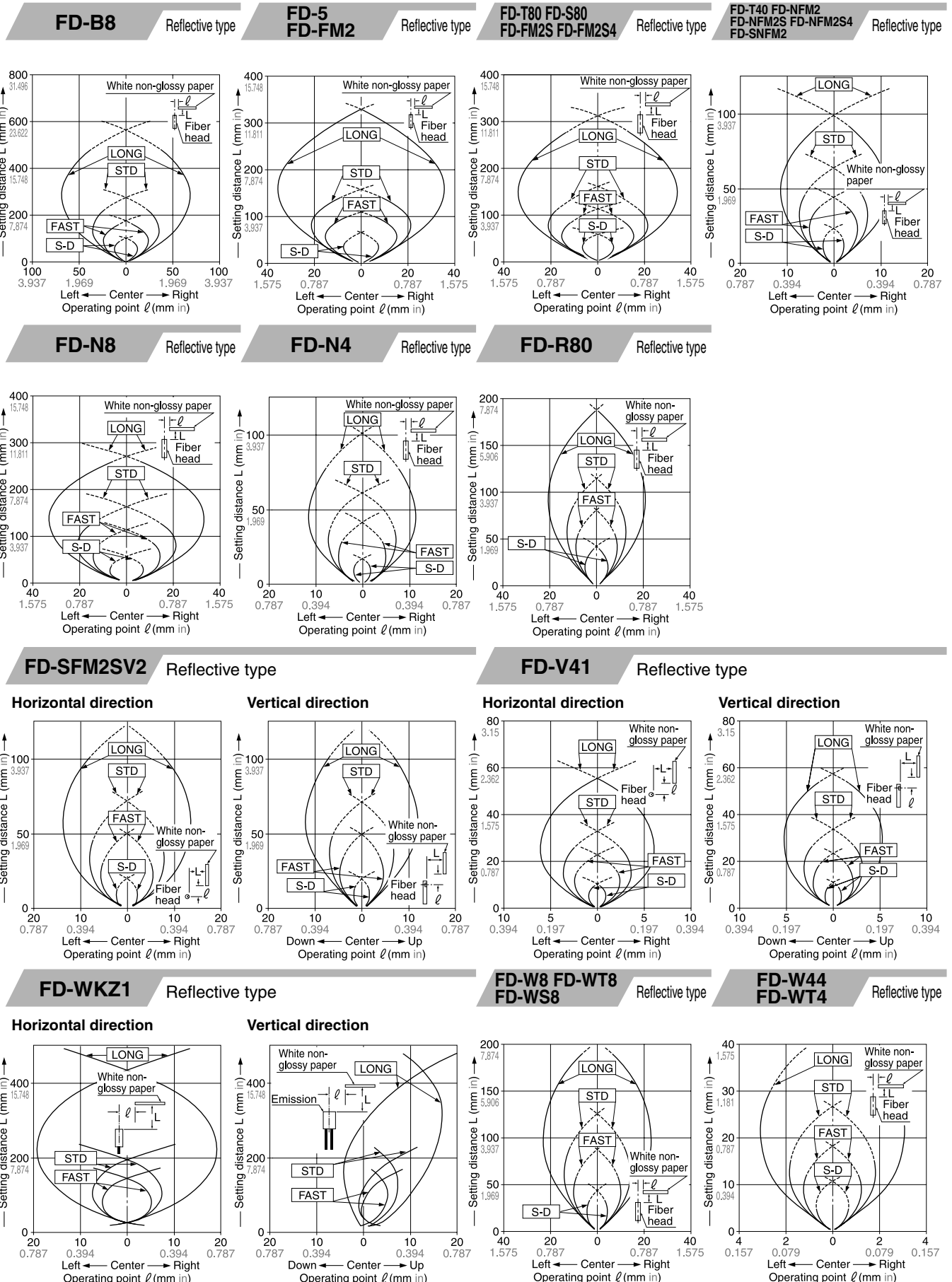


**FT-H20-M1** Thru-beam type



## SENSING CHARACTERISTICS (TYPICAL)

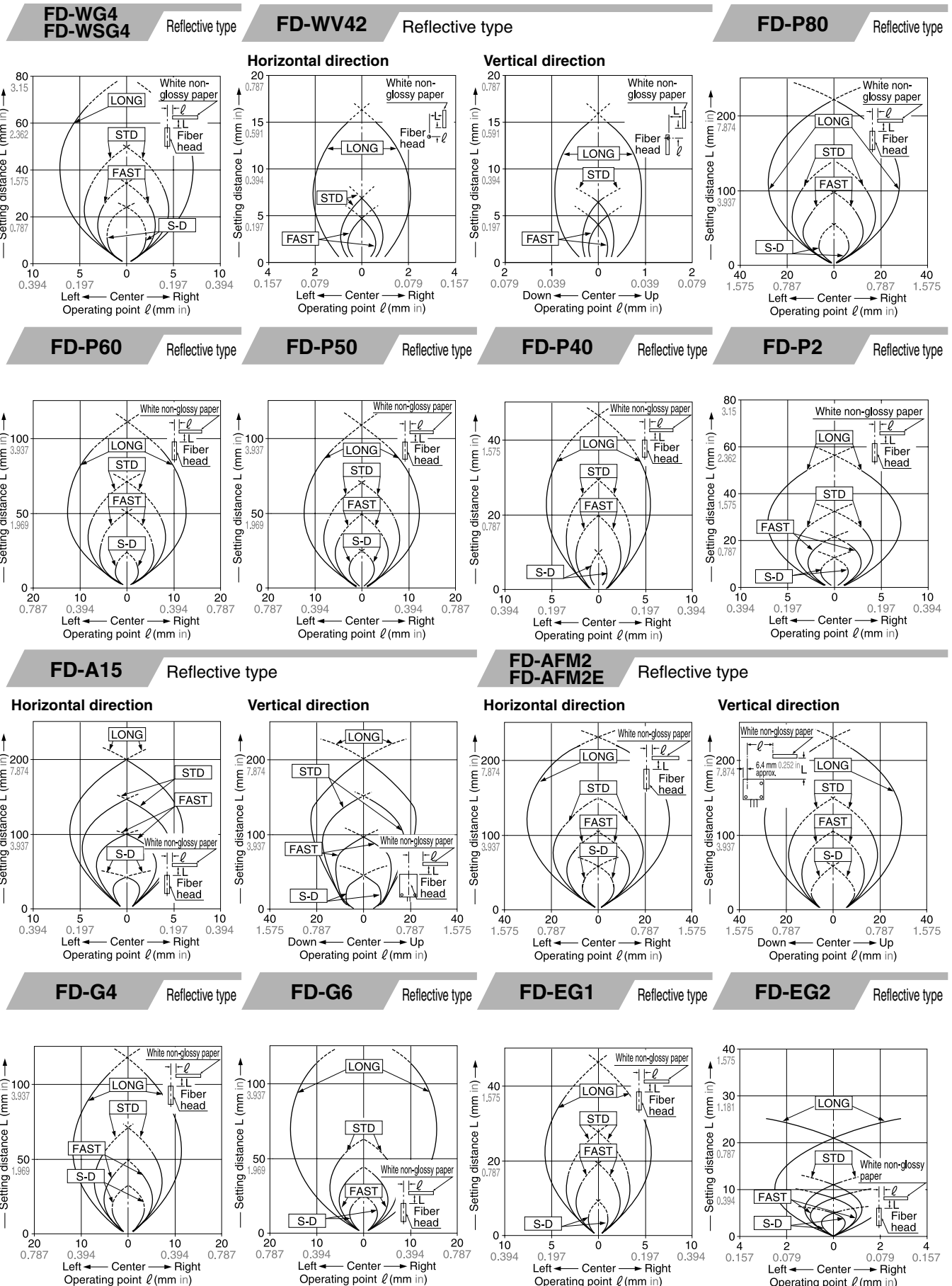
### Sensing fields



# FX-301

## SENSING CHARACTERISTICS (TYPICAL)

### Sensing fields

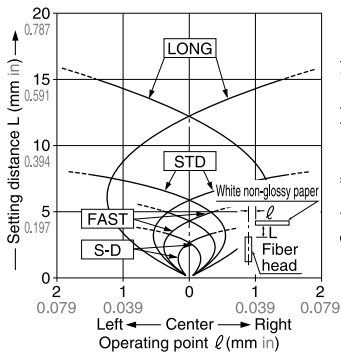


## SENSING CHARACTERISTICS (TYPICAL)

### Sensing fields

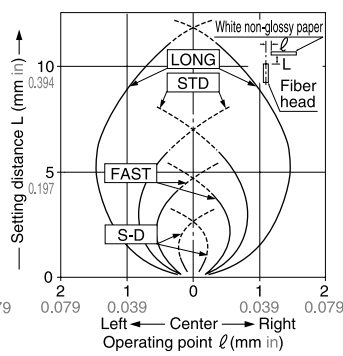
**FD-EG3**

Reflective type



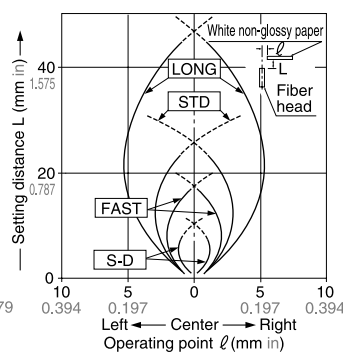
**FD-E12**

Reflective type



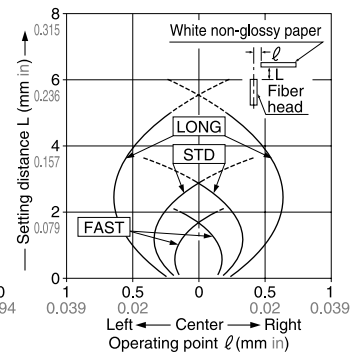
**FD-E22**

Reflective type



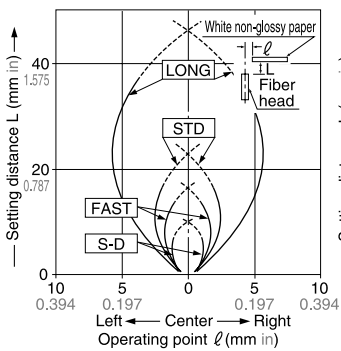
**FD-EN500S1**

Reflective type



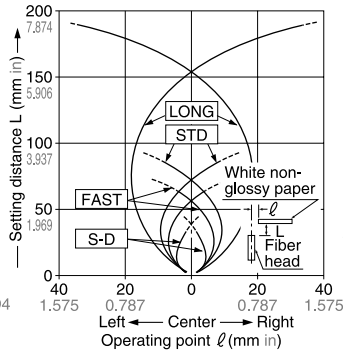
**FD-ENM1S1**

Reflective type



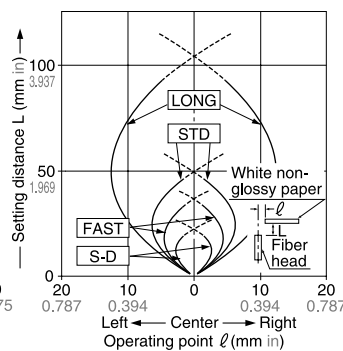
**FD-P81X**

Reflective type



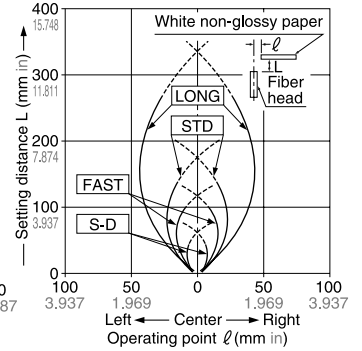
**FD-G6X**

Reflective type



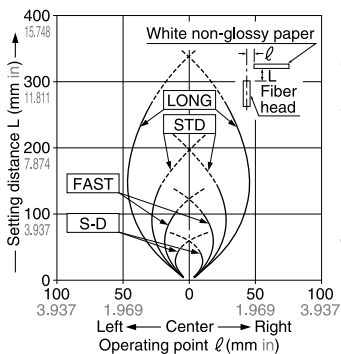
**FD-H35-M2**  
**FD-H35-M2S6**

Reflective type



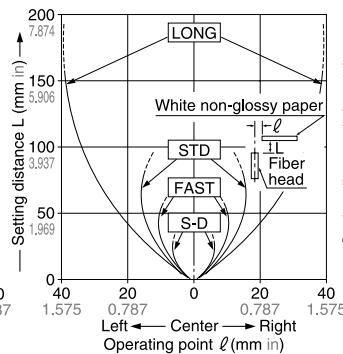
**FD-H20-M1**

Reflective type



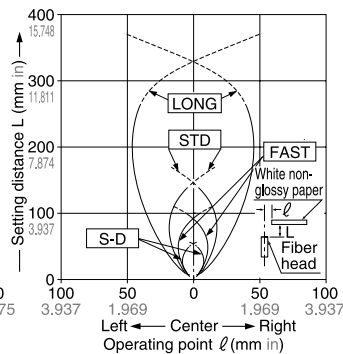
**FD-H35-20S**

Reflective type



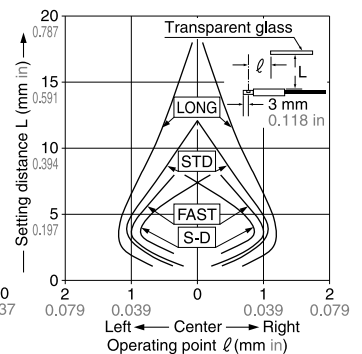
**FD-H20-21**

Reflective type



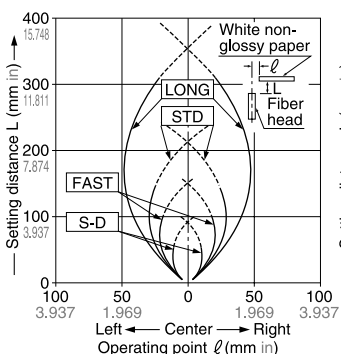
**FD-H30-L32**  
**FD-H18-L31**

Reflective type



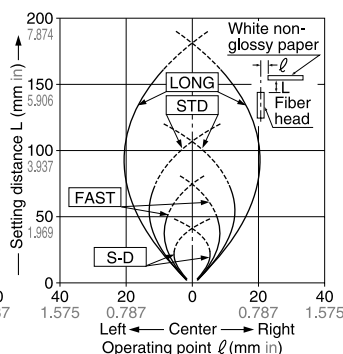
**FD-H13-FM2**

Reflective type



**FD-6V**

Reflective type



# FX-301

## PRECAUTIONS FOR PROPER USE

### Amplifier

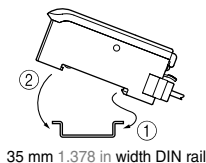


This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.

### Mounting

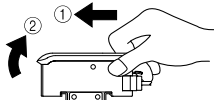
#### How to mount the amplifier

- Fit the rear part of the amplifier on a 35 mm 1.378 in width DIN rail.
- Press down the front part of the mounting section of the amplifier on the 35 mm 1.378 in width DIN rail.



#### How to remove the amplifier

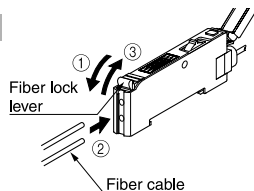
- Push the amplifier forward.
- Lift up the front part of the amplifier to remove it.



Note: Take care that if the front part is lifted without pushing the amplifier forward, the hook on the rear portion of the mounting section is likely to break.

#### How to connect the fiber cables

- Snap the fiber lock lever down.
- Insert fiber cables slowly into the inlets until they stop. (Note 1)
- Return the fiber lock lever to the original position, till it stops.



Notes: 1) In case the fiber cables are not inserted to a position where they stop, the sensing range reduces.

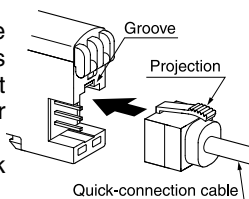
2) With the coaxial reflective type fiber, such as **FD-G4** or **FD-FM2**, insert the single-core fiber cable into the beam-emitting inlet and the multi-core fiber cable into the beam-receiving inlet. If they are inserted in reverse, the sensing accuracy will deteriorate.

### Connection

- Make sure that the power supply is off while connecting or disconnecting the quick-connection cable.

#### Connection method

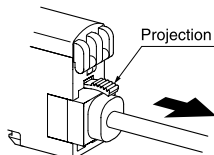
- Holding the connector of the quick-connection cable, align its projection with the groove at the top portion of the amplifier connector.
- Insert the connector till a click is felt.



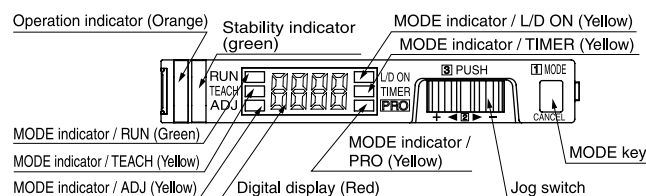
#### Disconnection method

- Pressing the projection at the top of the quick-connection cable connector, pull out the connector.

Note: Take care that if the connector is pulled out without pressing the projection, the projection may break. Do not use a quick-connection cable whose projection has broken. Further, do not pull by holding the cable, as this can cause a cable-break.



### Part description

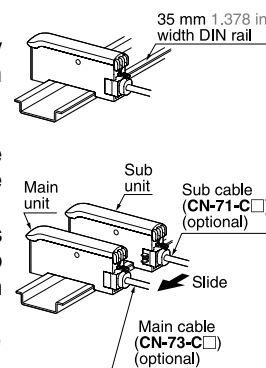


### Cascading amplifiers

- Make sure that the power supply is off while cascading or removing the amplifier.
- Make sure to check the allowable ambient temperature, as it depends on the number of amplifiers connected in cascade.
- In case two, or more, amplifiers are connected in cascade, make sure to mount them on a DIN rail.
- When connecting in cascade, mount the amplifiers close to each other, fitting them between the optional end plates (**MS-DIN-E**) mounted at the two ends.
- When the amplifiers move on the DIN rail depending on the attaching condition, fitting them between the optional end plates (**MS-DIN-E**) mounted at the two ends.
- Up to maximum 15 amplifiers can be added (total 16 amplifiers connected in cascade.)
- When connecting more than two amplifiers in cascade, use the sub cable (**CN-71-C**) as the quick-connection cable for the second amplifier onwards.
- Between the **FX-301B(P)/G(P)/H(P)** and the **FX-301(P)**, the setting status copy function via communication signal cannot be used. If coupling these, please arrange identical models one at a time.

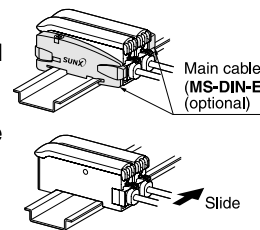
#### Cascading method

- Mount the amplifiers, one by one, on the 35 mm 1.378 in width DIN rail. (For details, refer to 'Mounting'.)
- Slide the sub units next to the main unit, and connect the quick-connection cables.
- Mount the optional end plates (**MS-DIN-E**) at both the ends to hold the amplifiers between their flat sides.
- Tighten the screws to fix the end plates (**MS-DIN-E**).



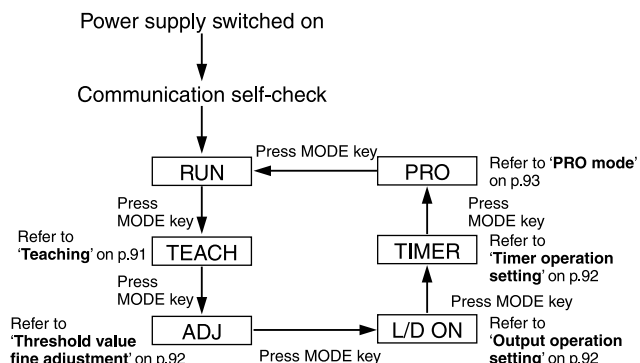
#### Dismantling

- Loosen the screws of the end plates (**MS-DIN-E**).
- Remove the end plates (**MS-DIN-E**).
- Slide the sub units and remove them one by one. (For details, refer to 'Mounting'.)



### Operation procedure

- When the power supply is switched on, communication self-check is carried out and normal condition is displayed [MODE indicator / RUN (green) lights up and the digital display shows incident light intensity].
- When MODE key is pressed, the mode changes as per the diagram below.



When jog switch is pressed, the setting is confirmed. When MODE key is pressed for 2 sec., or more, the sensor returns to the RUN mode. Cancellation is possible by pressing MODE key during setting.

## PRECAUTIONS FOR PROPER USE

### Amplifier

#### Teaching

- The threshold values can be set by 2-level teaching, limit teaching or full-auto teaching, when the MODE indicator / TEACH (yellow) lights up.

#### In case of 2-level teaching

- This is the method of setting the threshold value by teaching two levels, corresponding to the object present and object absent conditions. Normally, setting is done by this method.

Step	Description	Display
①	Set the fiber within the sensing range. Press MODE key to light up MODE indicator / TEACH (yellow).	
②	Press jog switch in the object present condition. If the teaching is accepted, the read incident light intensity blinks in the digital display. <b>Thru-beam type</b> <b>Reflective type</b>	
③	MODE indicator / TEACH (yellow) blinks. Press jog switch in the object absent condition. <b>Thru-beam type</b> <b>Reflective type</b>	
④	If the teaching is accepted, the read incident light intensity blinks in the digital display and the threshold value is set at the mid-value between the incident light intensities in the object present and the object absent conditions. After this, the judgment on the stability of sensing is displayed. • In case stable sensing is possible: '9000' is displayed. Stability indicator (green) blinks. • In case stable sensing is not possible: '88r0' blinks. Stability indicator (green) is off.	 
⑤	The threshold value is displayed.	
⑥	'....' blinks in the digital display.	
⑦	The incident light intensity appears in the digital display and the setting is complete.	

Note: Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

#### In case of full auto-teaching FX-301B(P)/G(P)/H(P) only

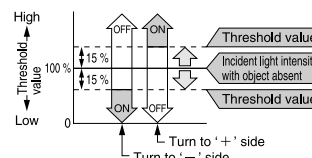
- Full auto-teaching is used when it is desired to set the threshold value without stopping the assembly line, with the object in the moving condition.

Step	Description	Display
①	Set the fiber within the sensing range. Press MODE key to light up MODE indicator / TEACH (yellow).	
②	Press the jog switch continuously for 0.5 sec. or more with the object moving on the assembly line. (The incident light intensity is displayed during sampling.)	
③	'Aut0' is displayed on the digital display. Release the jog switch when the object has passed.	
④	If the teaching is accepted, the read incident light intensity blinks in the digital display and the threshold value is set at the mid-value between the incident light intensities in the object present and the object absent conditions. After this, the judgment on the stability of sensing is displayed. • In case stable sensing is possible: '9000' is displayed. Stability indicator (green) blinks. • In case stable sensing is not possible: '88r0' blinks. Stability indicator (green) is off.	 
⑤	The threshold value is displayed.	
⑥	'....' blinks in the digital display.	
⑦	The incident light intensity appears in the digital display and the setting is complete.	

#### In case of limit teaching

- This is the method of setting the threshold value by teaching only the object absent condition (stable incident light condition). This is used for detection in the presence of a background body or for detection of small objects.

Step	Description	Display
①	Set the fiber within the sensing range. Press MODE key to light up MODE indicator / TEACH (yellow).	
②	Press jog switch in the object absent condition. If the teaching is accepted, the read incident light intensity blinks in the display. <b>Thru-beam type</b> <b>Reflective type</b>	
③	MODE indicator / TEACH (yellow) blinks. Turn jog switch to the '+' side or '-' side.	
④	If jog switch is turned to the '+' side, '+' scrolls (twice) the display from right to left, and the threshold level is shifted to a value approx. 15% higher (lower sensitivity) than that set at ②. (Note 1) This is used in case of reflective type fibers. If jog switch is turned to the '-' side, '-' scrolls (twice) the display from left to right, and the threshold level is shifted to a value approx. 15% lower (higher sensitivity) than that set at ②. (Note 1) This is used in case of thru-beam type fibers.	
⑤	After this, the judgment on whether the setting shift amount can be shifted or not is displayed. • In case shifting is possible: '9000' blinks. • In case shifting is not possible: '88r0' blinks.	 
⑥	The threshold value is displayed.	
⑦	'....' blinks in the digital display.	
⑧	The incident light intensity appears in the digital display and the setting is complete.	



- Notes: 1) The approx. 15% amount of shift is the initial value. The amount of shift can be changed in the PRO mode from approx. 5 to 80% (5% step). Refer to the 'Fiber Sensor Guide Book' or 'SUNX fiber sensor home page' (<http://www.fiber-sensor.com>) for more details pertaining to setting instructions.  
2) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

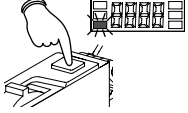

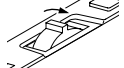

- Notes: 1) The threshold value's shift amount can be selected in PRO mode. Refer to the 'SUNX fiber sensor home page' (<http://www.fiber-sensor.com>) for more details pertaining to setting instructions. (Increments of 5% between -45 and 45% for setting possible. 0% default.)  
2) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

# FX-301

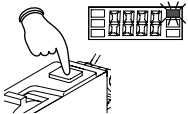

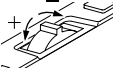


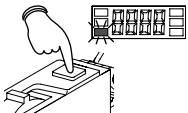

## PRECAUTIONS FOR PROPER USE

### Amplifier

#### Threshold value fine adjustment

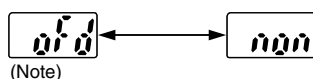
Step	Description	Display
①	Press MODE key to light up MODE indicator / ADJ (yellow). 	—
②	In case the threshold value is to be increased (sensitivity to be reduced), turn the jog switch to the '+' side to increase the threshold value slowly. If the jog switch is turned continuously to the '+' side, the threshold value increases rapidly.  In case the threshold value is to be decreased (sensitivity to be increased), turn the jog switch to the '-' side to decrease the threshold value slowly. If the jog switch is turned continuously to the '-' side, the threshold value decreases rapidly. 	0334 ↓ 0335 or 0334 ↓ 0333
③	When jog switch is pressed, the threshold value is confirmed. 	—

#### Output operation setting

Step	Description	Display
①	Press MODE key to light up MODE indicator / L/D ON (yellow). 	 Displays present setting
②	If the jog switch is turn to the '+' or '-' direction, the output operation setting will change. 	Light state  ↑ ↓ Dark state 
③	When jog switch is pressed, the threshold value is confirmed. 	 Displays selected setting

#### Timer operation setting

- The setting for whether the timer is used or not can be done when MODE indicator / TIMER (yellow) lights up.
- 10 ms OFF-delay (initial value) timer is automatically set when the timer is set to be used.
- Further, an OFF-delay (initial value) which is useful when the response of the connected device is slow, etc., an ON-delay which is useful to detect only objects taking a long time to travel, and ONE SHOT, which is useful when the input specifications of the connected device require a signal of a fixed width, are possible with the **FX-301** series. Refer to the 'Fiber Sensor Guide Book' or 'SUNX fiber sensor home page' (<http://www.fiber-sensor.com>) for the setting method of the OFF-delay, ON-delay and ONE SHOT timer intervals.



Note: The OFF-delay timer interval set in the PRO mode is displayed. Refer to the 'Fiber Sensor Guide Book' or 'SUNX fiber sensor home page' (<http://www.fiber-sensor.com>) for more details.

#### Key-lock function

- With the **FX-301B(P)/G(P)/H(P)**, if jog switch and MODE key are pressed for more than 3 sec. at the same time in 'RUN' mode condition, the key operations are locked, and only the threshold value confirmation function or the adjust function (valid only when the adjust lock function is canceled) is valid. To cancel the lock function, press both the keys for more than 3 sec. once again.

#### Wiring

- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- Take care that short-circuit or wrong wiring of the load may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Ensure that an isolation transformer is utilized for the DC power supply. If an auto transformer is utilized, the main amplifier or power supply may be damaged.
- Make sure to use the optional quick-connection cable for the connection of the amplifier. Extension up to total 100 m 328.084 ft is possible with 0.3 mm<sup>2</sup>, or more, cable. However, in order to reduce noise, make the wiring as short as possible.

#### Others

- Do not use during the initial transient time (0.5 sec. approx.) after the power supply is switched on.
- Take care that the sensor is not directly exposed to fluorescent light from a rapid-starter lamp or a high frequency lighting device, as it may affect the sensing performance.
- This sensor is suitable for indoor use only.
- Avoid dust, dirt, and steam.
- Take care that the product does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- This sensor cannot be used in an environment containing inflammable or explosive gasses.
- Never disassemble or modify the sensor.

## PRECAUTIONS FOR PROPER USE

### Amplifier

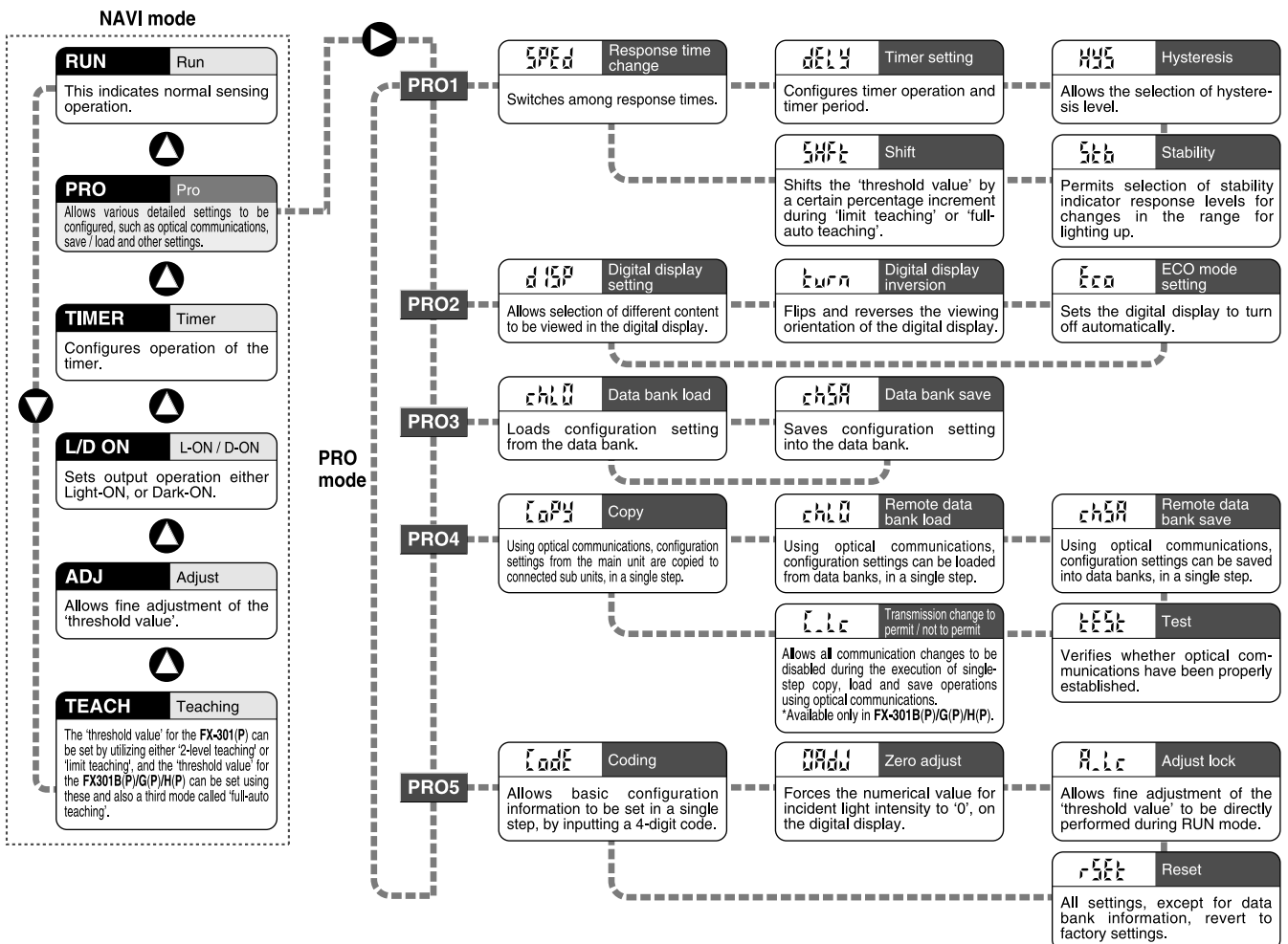
#### PRO mode

- Refer to the 'Fiber Sensor Guide Book' for more details pertaining to the PRO mode settings and procedures.



- The above can also be download from 'SUNX fiber sensor homepage' (<http://www.fiber-sensor.com>)
- PRO settings can be done when MODE indicator / PRO (yellow) lights up.

Table for PRO mode settings





# FX-301

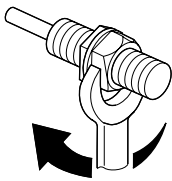
## PRECAUTIONS FOR PROPER USE

### Fiber

#### Mounting

- The tightening torque must not exceed the values given below.

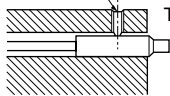
#### Mounting with a nut (threaded head type)



	Tightening torque
M3	0.39 N·m
M4	0.58 N·m (350 °C 662 °F heat-resistant fiber and FT-H20W-M□: 0.98 N·m, FD-H35-20S: 0.58 N·m)
M5 M6	0.98 N·m (350 °C 662 °F heat-resistant fiber: 1.96 N·m)
M14	1.47 N·m

#### Mounting with a set screw

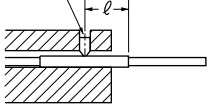
Set screw (cup point)  
M3 or less



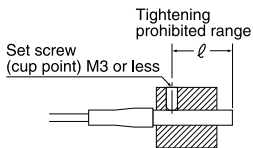
Tightening torque: 0.29 N·m or less  
(FT-SFM2L: 0.19 N·m  
FT-H20W-M□: 0.49 N·m)

- Fibers for which the tightening section has been specified should be fixed at  $\ell$  mm from the tightening section tip. (However, for FT-K8, FT-KV8, FT-WKV8 and FT-V10 ' $\ell$ ') indicates the range over which tightening cannot be done.)

Set screw (cup point)  
M3 or less



<FT-K8, FT-KV8, FT-WKV8, FT-V10>

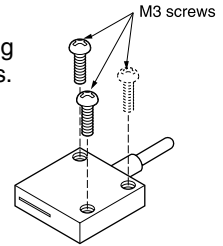


	$\ell$ (mm in)	Tightening torque
FT-PS1	3 0.118	0.1 N·m
FD-E12	4 0.157 (Note 1)	0.29 N·m
FT-V22 FT-41, FD-V41 FT-SFM2SV2	10 0.394	0.19 N·m
FD-EG1	10 0.394	0.29 N·m
FT-WV42 FD-WV42	15 0.591	0.29 N·m
FD-SFM2SV2	7 0.276	0.34 N·m
FT-KV8, FT-WKV8 FT-V10	13 0.512	0.3 N·m
FT-K8	12 0.472	

Notes 1): Excluding the sleeve.  
2): When installing, make sure to use screws smaller than the fiber diameter.

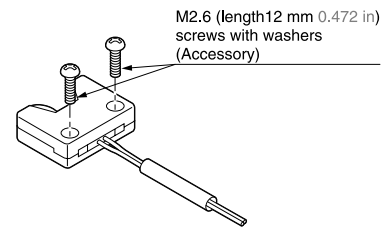
#### Mounting array fiber

- Using M3 screws, the tightening torque should be 0.58 N·m or less.



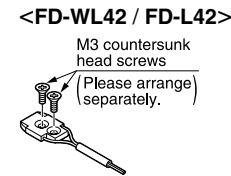
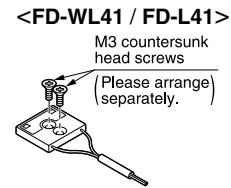
#### Mounting FD-L4

- Using M2.6 (length 12 mm 0.472 in) screws with washers (accessory), the tightening torque should be 0.3 N·m or less.



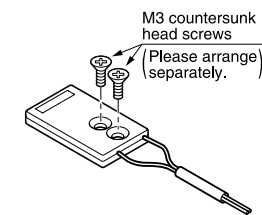
#### Mounting FD-WL41 / FD-L41 and FD-WL42 / FD-L42

- Using M3 countersunk head screws, the tightening torque should be 0.3 N·m or less.



#### Mounting FD-L43

- Using M3 countersunk head screws, the tightening torque should be 0.3 N·m or less.



## PRECAUTIONS FOR PROPER USE

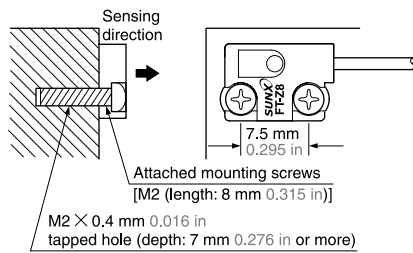
### Fiber

#### Mounting FT-Z8□ and FT-WZ8□

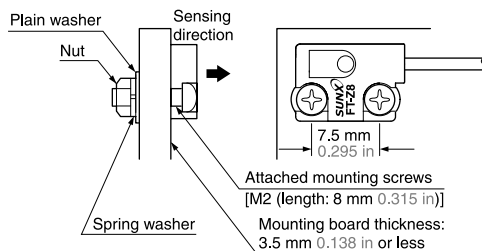
- Mount the fiber head by using the enclosed set of screws. The tightening torque should be 0.15 N·m or less
- If the fiber head is mounted in places subject to vibrations or shocks, use a screw-locking adhesive, etc.
- Mount each fiber head as given below.

#### <FT-Z8 / FT-WZ8 (Front sensing type)>

In case of tapping the mounting section

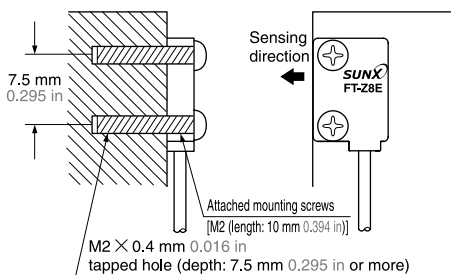


In case of using attached screw and nut

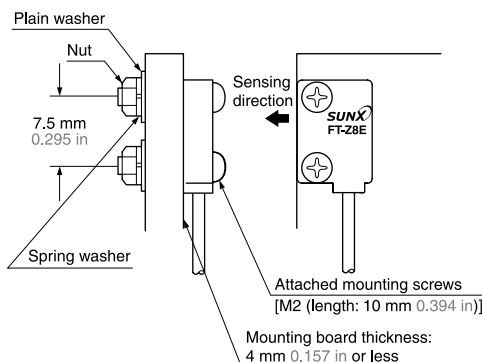


#### <FT-Z8E / FT-WZ8E (Side sensing type)>

In case of tapping the mounting section

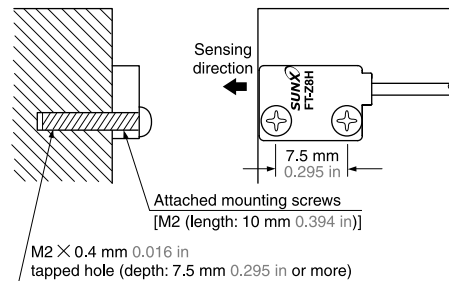


In case of using attached screw and nut

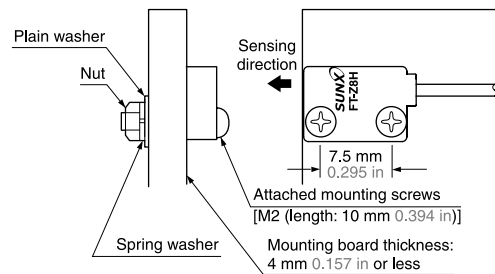


#### <FT-Z8H / FT-WZ8H (Top sensing type)>

In case of tapping the mounting section

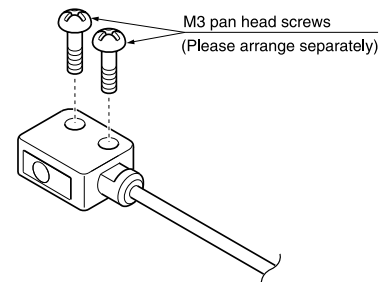


In case of using attached screw and nut



#### Mounting FT-Z802Y

- Using M3 pan head screws, the tightening torque should be 0.3 N·m or less.



#### Mounting FD-WKZ1

<If not using the attached mounting brackets>

- Use M3 or less set screws (cup point), and affix the head within 15 mm (0.591 in) from the tip of the fiber head. Do not exceed a torque of 0.3 N·m when tightening.

<If using the attached mounting brackets>

- The head can be affixed even without using the set screws.
- If using the set screws, use M3 set screws (cup point) to affix and do not exceed a torque of 0.05 N·m when tightening.

#### Mounting FD-A15

- Using M3 screws, the tightening torque should be 0.3 N·m or less.

#### Mounting FD-H30-L32 / FD-H18-L31

- Using M3 screws, the tightening torque should be 3 N·m or less.

# FX-301

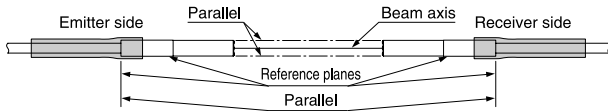
## PRECAUTIONS FOR PROPER USE.

### Fiber

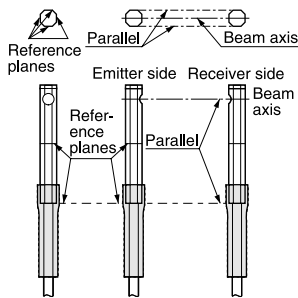
#### Narrow beam type fiber mounting

- Take care that, since the aperture angle of this product is very narrow, the beam may not be received depending upon the setting. At the time of installation, determine a reference plane, as shown in the figure below, and taking sufficient care against beam misalignment or tilt, install the emitting and receiving fibers so that they are parallel.

#### <FT-K8>

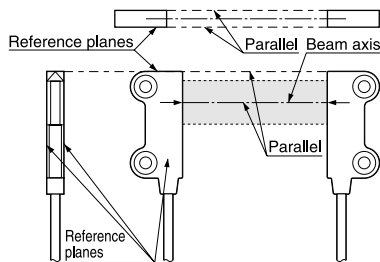


#### <FT-KV8 / FT-WKV8>

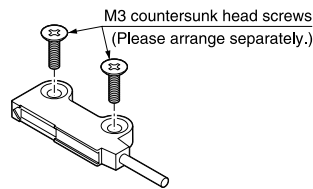


#### Thru-beam type wide beam fiber mounting

- Take care that, since the aperture angle of this product is very narrow, the beam may not be received depending upon the setting. At the time of installation, determine a reference plane, as shown in the figure below, and taking sufficient care against beam misalignment or tilt, install the beam-emitting and receiving fibers so that they are parallel.

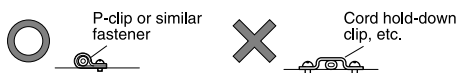


- Install the fiber using M3 countersunk head screws. The tightening torque should be 0.3 N·m or less. Further, when using the fiber at places having intense vibrations, use a screw-locking adhesive, etc.
- If mineral oil or solvent containing mineral oil component adheres to the sensing surface, the lens may be deformed. Take sufficient care to handle them.



#### Method of fixing fiber cable

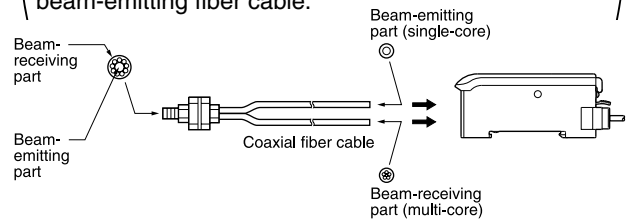
- If fixing the fiber cable in position, make sure that it is set in a manner as shown below, so that no load is applied on the fiber. (Excluding FT-H35-M2, FT-H35-M2S6, FD-H35-M2 and FD-H35-M2S6)



#### Connection with reflective coaxial type fiber

- With reflective coaxial type fiber, insert the center fiber cable (single-core) into the beam-emitting inlet and the outer fiber cable (multi-core) into the beam-receiving inlet.

FD-H35-M2 or FD-H20-M1 is marked 'P' on the beam-emitting fiber cable and 'D' on the beam-receiving fiber cable. FD-WG4, FD-WSG4 and FD-G4, FD-G6, FD-G6X are composed of beam-emitting and beam-receiving fiber cables that are different in diameter. FD-G500, FD-EG1, FD-EG2, FD-EG3, FD-E22, FD-H20-21 and FD-ENM1S1 are marked 'P' on the beam-emitting fiber cable.

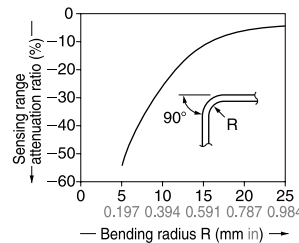


- Notes: 1) In case the fiber cables are not inserted to a position where they stop, the sensing range reduces.  
2) Before connecting fiber cables to the amplifier, mount the fiber attachments on their ends.

#### Fiber cable bending radius

- If the fiber cable is bent at a smaller bending radius than allowable bending radius, the sensing range decreases due to beam attenuation.

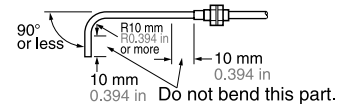
#### For a allowable bending radius of 25 mm (0.984 in)



Note: Please note that the 350 °C 662 °F heat-resistant fibers, vacuum-resistant and chemical-resistant fibers cannot bend less than the allowable bending radius.

#### How to bend sleeve

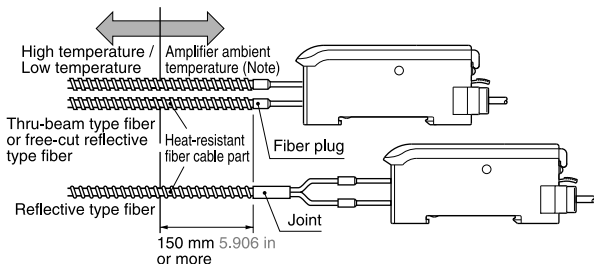
- The bending radius must be R10 mm R0.394 in or more. Please bend gradually using the fiber bender (FB-1) or a round bar of  $\phi$ 20 mm  $\phi$ 0.787 in or more.



- Note: Do not bend the sleeve of side-view type, narrow beam type, narrow-view type and ultra-small diameter type fiber.

#### Use of heat-resistant type fiber

- Use by keeping 150 mm 5.906 in, or more, of the heat-resistant fiber cable part at normal temperature.



- Protect the amplifier from heat radiation or hot air.
- With the 350 °C 662 °F heat-resistant type fiber, the surface of the fiber head or the spiral may be discolored by heat. However, this does not affect its performance.

## PRECAUTIONS FOR PROPER USE.

### Fiber

#### Fiber attachments (FX-AT□)

##### Product outline

- When the beam-emitting and beam-receiving fiber cables are inserted into the fiber sensor amplifier (FX-301/302/303/311 series etc.), the enclosed fiber attachment (FX-AT2/AT3/AT4/AT5/AT6) facilitates insertion of the fiber cables and reduces the possibility of incorrect fiber cable insertion.

##### Cautions

- Take care that FX-AT2, FX-AT3, FX-AT4, FX-AT5 and FX-AT6 cannot be used with fiber sensor amplifiers having a pitch, between the beam-emitting and the beam-receiving fiber cables, other than 7 mm 0.276 in. In case of fiber sensor amplifiers having a pitch other than 7 mm 0.276 in, please use attachments FX-AT10 or FX-AT13. (accessory)

##### Component description

##### <FX-AT2>

Attachment for fixed-length fiber: orange



##### <FX-AT3>

Attachment for  $\phi 2.2$  mm  $\phi 0.087$  in fiber: clear orange



##### <FX-AT4>

Attachment for  $\phi 1$  mm  $\phi 0.039$  in fiber: black



##### <FX-AT5>

Attachment for  $\phi 1.3$  mm  $\phi 0.051$  in fiber: gray



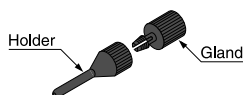
##### <FX-AT6>

Attachment for  $\phi 1$  mm /  $\phi 1.3$  mm  $\phi 0.039$  in /  $\phi 0.051$  in mixed fiber  
(for  $\phi 1$  mm  $\phi 0.039$  in fiber: black,  
for  $\phi 1.3$  mm  $\phi 0.051$  in fiber: gray)



##### <FX-AT10>

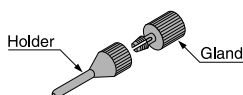
Attachment for  $\phi 1$  mm  $\phi 0.039$  in fiber: black



This is enclosed by FX-AT4.

##### <FX-AT13>

Attachment for  $\phi 1.3$  mm  $\phi 0.051$  in fiber: gray

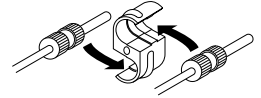


This is enclosed by FX-AT5.

#### Mounting

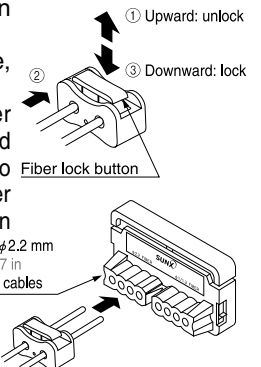
##### <FX-AT2>

- Mount the plug part of the fiber cables in FX-AT2, as shown in the figure below. (The resin plug has a groove to hold it in place.)
- Connect the fiber cables, in condition ①, to the fiber sensor amplifier.



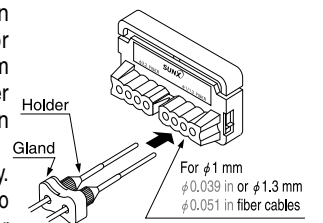
##### <FX-AT3>

- Confirm that the fiber lock button of FX-AT3 is in unlock side.
- Insert the fiber cables one by one, in condition ①.
- After inserting, press down the fiber lock button. The fiber cables are fixed at the desired position. (In order to unlock the fiber cables, press the fiber lock button towards unlock direction from the opposite side.)
- Insert the fiber cables into the holes for  $\phi 2.2$  mm  $\phi 0.087$  in fiber cables of the fiber cutter (FX-CT2) from the direction shown in the figure right.
- Cut both fiber cables simultaneously. (At this time, place the attachment without any gap against the fiber cutter. The fiber cables will be cut at a position approx. 10.5 mm 0.413 in from the tip of the fiber cable.)
- After cutting, connect the fiber cables to the fiber sensor amplifier immediately.



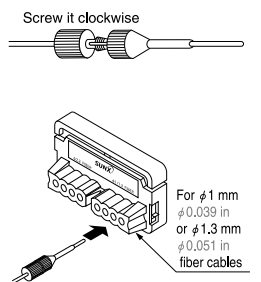
##### <FX-AT4, FX-AT5, FX-AT6>

- Mount the holders on the gland lightly.
  - Notes: 1) If both long holders and short holders are enclosed with the fiber, use the short holders.
  - 2) In case of FX-AT6, match the colors of the holders and the gland. The black color is for  $\phi 1.0$  mm  $\phi 0.039$  in fiber cable and the gray color is for  $\phi 1.3$  mm  $\phi 0.051$  in fiber cable.
- Insert the fiber cables into the holders, in condition ①.
- Tighten the holders to fix the fiber cables at the desired length.
- Insert the fiber cables, in condition ③, into the holes for  $\phi 1.0$  mm  $\phi 0.039$  in or  $\phi 1.3$  mm  $\phi 0.051$  in fiber cables of the fiber cutter (FX-CT2) from direction shown in the figure right.
- Cut both fiber cables simultaneously. (At this time, insert the attachment to a position at which it stops. The fiber cables will be cut at a position approx. 0.5 mm 0.020 in from the holder.)
- After cutting, insert the fiber cables to the fiber sensor amplifier immediately.



##### <FX-AT10, FX-AT13>

- Thread the fiber cable through the gland and holder separately, and screw the gland into the holder clockwise.
- Insert the fiber cables one by one into the holes for  $\phi 1.0$  mm  $\phi 0.039$  in or  $\phi 1.3$  mm  $\phi 0.051$  in fiber cable of the fiber cutter (FX-CT2) from the direction shown in the figure right. (At this time, insert the attachment to a position at which it stops. The fibers will be cut at a position approx. 0.5 mm 0.020 in from the holder.)



# FX-301

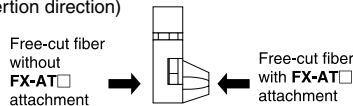
## PRECAUTIONS FOR PROPER USE.

### Fiber

#### Fiber cutter (FX-CT2)

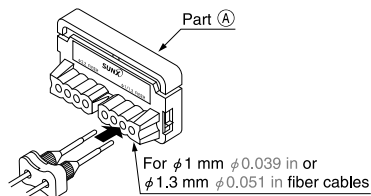
- To cut the fiber cables, insert them from the direction shown below.

(Fiber cable insertion direction)



#### How to use fiber cutter (FX-CT2)

- Slide part (A) of the fiber cutter fully upward till it stops.
- Insert the fiber cables, mounted in the attachment, till they stop.  
 (Take care that there are separate fiber insertion cable holes for  $\phi 2.2$  mm  $\phi 0.087$  in and  $\phi 1.0$  mm  $\phi 0.039$  in or  $\phi 1.3$  mm  $\phi 0.051$  in fiber cables.)
- Slide part (A) of the fiber cutter down to cut the fibers.



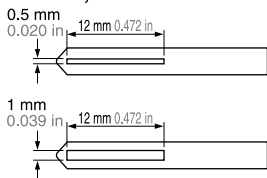
- Notes: 1) The fiber cables should be cut in one stroke.  
 2) Once a fiber cable is cut off at a hole, do not use the hole again. If used, it degrades the cut surface quality and the detectability may deteriorate.  
 3) The blade cannot be replaced. Please purchase an additional fiber cutter, if required.  
 4) Note that the sensing range may be reduced by up to 20 % depending on the cut condition. Hence, decide the setting distance by taking sufficient margin.

#### Seal type slit mask for FT-WA30/A30, FT-WA8/A8

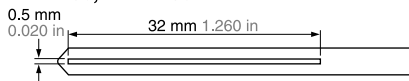
- Two types of slit masks are enclosed. (one type for FT-A30 and FT-WA30) Apply the enclosed slit mask when detecting small objects or as measures not to saturate the emitted light amount for short-range sensing. However, the sensing range is reduced when the slit mask is mounted. As the slit mask is seal type, stick it by aligning the projection of the slit mask with the upper portion of the fiber head, as shown in the figure below.

#### Slit masks

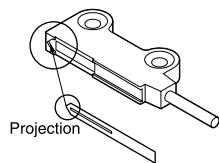
##### <FT-A8, FT-WA8>



##### <FT-A30, FT-WA30>



#### Mounting

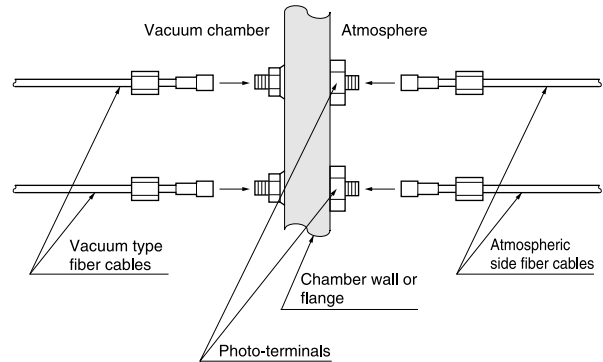


#### Sensing range when mounting slit mask [with FX-301(P)]

- FT-WA30/A30:** 2,500 mm 98.425 in (LONG) / 1,000 mm 39.370 in (STD) / 600 mm 23.622 in (FAST) / 200 mm 7.874 in (S-D)
- FT-WA8/A8:** 400 mm 15.748 in (LONG) / 200 mm 7.874 in (STD) / 140 mm 5.512 in (FAST) / 70 mm 2.756 in (S-D) (0.5 × 12 mm 0.020 × 0.472 in slit mask)
- FT-WA8/A8:** 800 mm 31.496 in (LONG) / 400 mm 15.748 in (STD) / 280 mm 11.024 in (FAST) / 140 mm 5.512 in (S-D) (1 × 12 mm 0.039 × 0.472 in slit mask)

#### Vacuum type fiber

##### Configuration

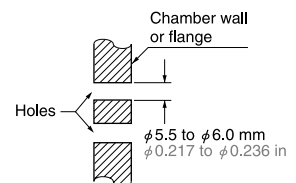


Leakage:  $1.33 \times 10^{-10}$  Pa·m<sup>3</sup>/sec. [He] or less

##### Mounting

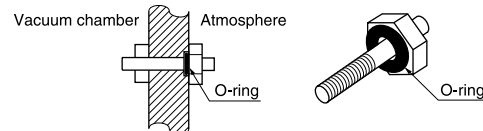
- Make two holes on the vacuum tank wall (chamber wall or flange).

Note: The hole diameter must be from  $\phi 5.5$  to  $\phi 6.0$  mm  $\phi 0.217$  to  $\phi 0.236$  in.



- Mount the **FV-BR1** photo-terminal on the vacuum tank wall.

Notes: 1) The attached O-ring must be mounted.  
 2) The O-ring must be used at the atmospheric side.  
 3) The tightening torque should be 0.58 N·m or less.



- Mount the **FT-J6** atmospheric side fibers on the atmospheric side of the **FV-BR1** photo-terminals.

Notes: 1) The fixing nuts must be tightened securely. If not, the sensing range may decrease.  
 2) The tightening torque should be 0.58 N·m or less.



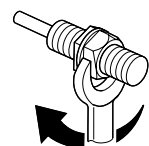
- Mount the vacuum type fibers on the vacuum side of the **FV-BR1** photo-terminals.

Notes: 1) The fixings rings of the vacuum type fibers must be tightened securely. If not, the sensing range may decrease.  
 2) The tightening torque should be 0.58 N·m or less.

- Fix the fiber head of the vacuum type fiber.

Note: The maximum tightening torque should be as given below.

	Tightening torque
M2.6	0.29 N·m
M4 M6	0.58 N·m

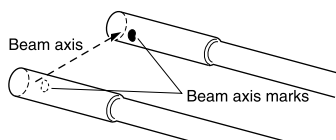


## PRECAUTIONS FOR PROPER USE.

### Fiber

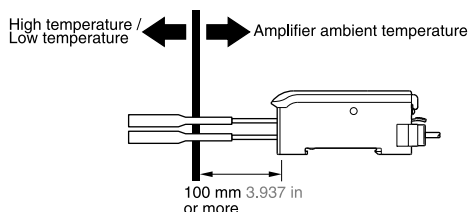
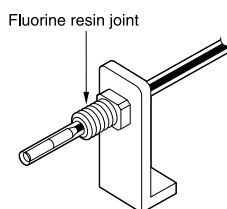
#### FT-L8Y/V8Y chemical-resistant type fiber

- Do not use it in the following chemicals:  
Dissolved alkali metals (Natrium, Potassium or Lithium),  
Fluorine gas (F<sub>2</sub>), ClF<sub>3</sub>, OF<sub>2</sub> (including gaseous state).
- The beam axis mark is indicated on the side-view fiber.  
Perform the beam alignment with the beam axis marks, on  
the receiver and the emitter, facing each other.



### Mounting

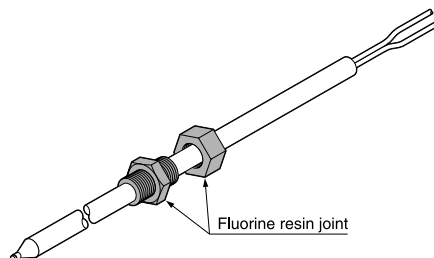
- Use a commercial Fluorine resin joint to mount the fiber.
- The bending radius of the protective jacket should be R30 mm 1.181 in or more. It will be damaged under the value.
- The bending radius of the bear fiber should be R25 mm R0.984 in or more. The sensing range will be shortened under the value.
- Do not subject the fiber under tension.
- Although the chemical-resistant type fiber is rated for use up to +115 °C +239 °F, place 100 mm 3.937 in or more of the fiber in the normal temperature area to protect the amplifier.



#### FD-F8Y liquid level sensing fiber

### Mounting

- Use a commercially available fluorine resin joint, etc., to install **FD-F8Y**.



### Cautions

- Take care that unclear liquid may not be sensed stably.
- Take care that the tube may stretch by maximum 2 % of the total length if it is used at a high temperature.
- Do not scratch the fiber jacket while cutting the fluorine resin tube.

# FX-301

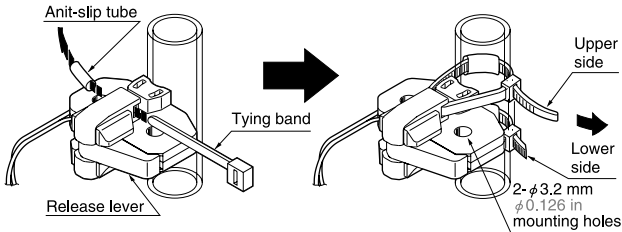
## PRECAUTIONS FOR PROPER USE.

### Fiber

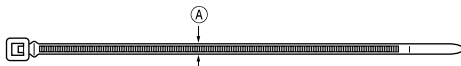
#### FD-F4□ and FD-F9□ liquid level sensing fiber

##### Mounting

- Mount the fiber head on a pipe with the attached tying bands and anti-slip tubes as shown in the figure below. Make sure that the release lever is retracted (position as in the fig.) before mounting. Fasten two tying bands, as shown, and cut off the excess portions.



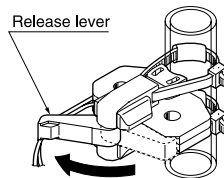
- If other tying bands are to be used, the dimension A shown in the figure below should be 2.5 mm 0.098 in or less.



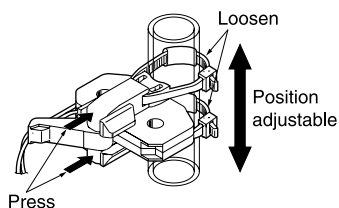
- In case of mounting using the two mounting holes, use M3 screws, plain washers, and spring washers. The tightening torque should be 0.5 N·m or less. (Please arrange the M3 screws, plain washers, and spring washers separately.)
- In case of mounting on the pipe with tying bands, the fiber position can be easily adjusted.

##### Adjustment

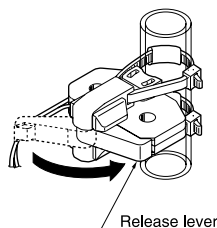
- Unlock the release lever (in the direction of the arrow).



- Press the movable center holders forward to loosen the tying bands and adjust the position.



- Lock the release lever to its original place.



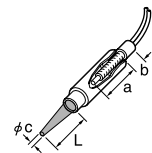
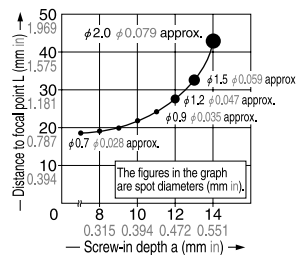
- Notes: 1) Whenever the mounting position is changed, adjust the sensitivity again.  
 2) The lever mechanism must be used only to adjust the position, and not for tightening the tying bands. If tying bands are tightened while the lever is open, and then the lever is locked, the fiber may be damaged.

##### Cautions

- Liquid in a pipe which is not transparent cannot be sensed correctly.
- Unclear or viscous liquid may not be sensed.
- Fit the fiber head to the pipe securely, otherwise the operation may be erroneous.
- Take care that no dew condenses on the pipe's sensing surface or the pipe's inside wall and no bubble attaches on the pipe's inside wall, since it can affect the operation.
- Neither the FD-F4□ or the FD-F9□ is waterproof or chemical-resistant. Installation should be avoided at any place where it could come in direct contact with water or chemicals.
- Do not apply excessive tensile force to the fiber cable.

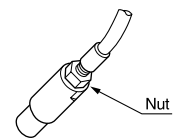
##### Cautions for FX-MR2 zoom lens usage

- The spot diameter and the sensing range are adjustable by the screw-in depth as follows.

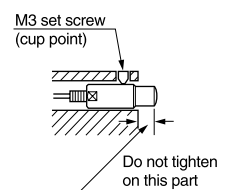


- a: Screw-in depth
- b: 25 - a
- L: Distance to focal point
- φc: Spot diameter

- After FX-MR2 is set on the fiber head at the desired depth, tighten the attached nut securely.

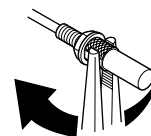


- To mount FX-MR2 with a set screw, use a M3 set screw (cup point). The tightening torque should be 0.29 N·m or less.



##### Caution for FX-MR3, FX-MR6 finest spot lens usage

- Screw FX-MR3, FX-MR6 on the fiber head until the fiber is fully inserted. The tightening torque should be 0.29 N·m or less.

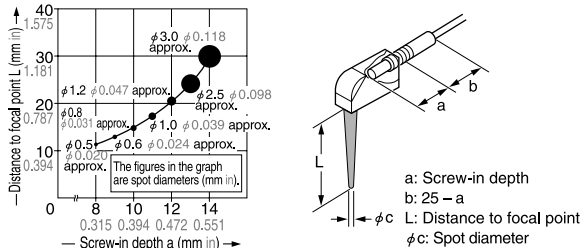


## PRECAUTIONS FOR PROPER USE.

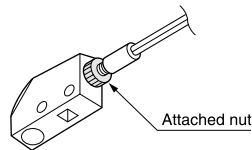
### Fiber

#### Cautions for FX-MR5 side-view zoom lens usage

- The spot diameter and the sensing range are adjustable by the screw-in depth as follows.



- After **FX-MR5** is set on the fiber head at the desired depth, tighten the attached nut **NT-FX-MR5** securely.



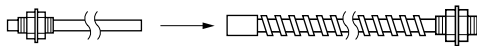
- The tightening torque should be 0.5 N·m or less when tightening **FX-MR5** with a screw.

#### Fitting protective tube

- The threaded head free-cut fiber can be fitted with a protective tube.

##### Fitting

- Insert the fiber cable into the protective tube from the sleeve side.

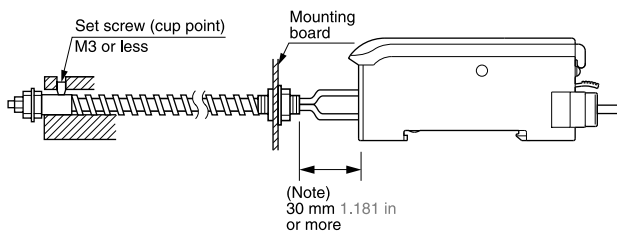


- Turn the fiber head to screw it on the inner thread of the sleeve.



##### Mounting

- The maximum tightening torque should be as given below.



#### <Sleeve part>

Tightening torque:  
0.58 N·m or less

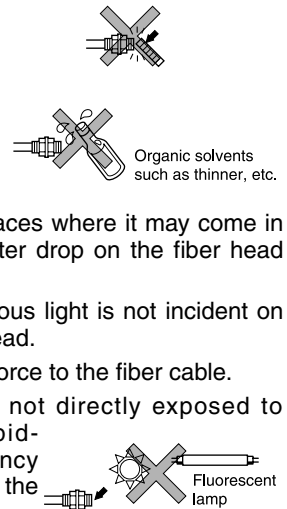
#### <Threaded part>

Tightening torque:  
0.58 N·m or less

Note: The fiber cable must be longer than the protective tube by 30 mm 1.181 in or more to connect it to the amplifier. Make sure to measure the length required before cutting.

#### Others

- Do not use the fiber at places having intense vibrations, as this can cause malfunction.
- Keep the fiber head surface intact. If it is scratched or spoiled, the detectability will deteriorate.
- Do not expose the fiber cable to any organic solvents. (Excluding chemical-resistant type fiber)
- Do not use the fiber head in places where it may come in direct contact with water. A water drop on the fiber head deteriorates the sensing.
- Ensure that any strong extraneous light is not incident on the receiving face of the fiber head.
- Do not apply excessive tensile force to the fiber cable.
- Take care that the sensor is not directly exposed to fluorescent light from a rapid-starter lamp or a high frequency lighting device, as it may affect the sensing performance.
- Since the sensing portion of the wide beam or narrow beam fiber is concave shaped, take care that dust or dirt does not collect on it. In case it does collect, wipe it with a dry soft cloth.

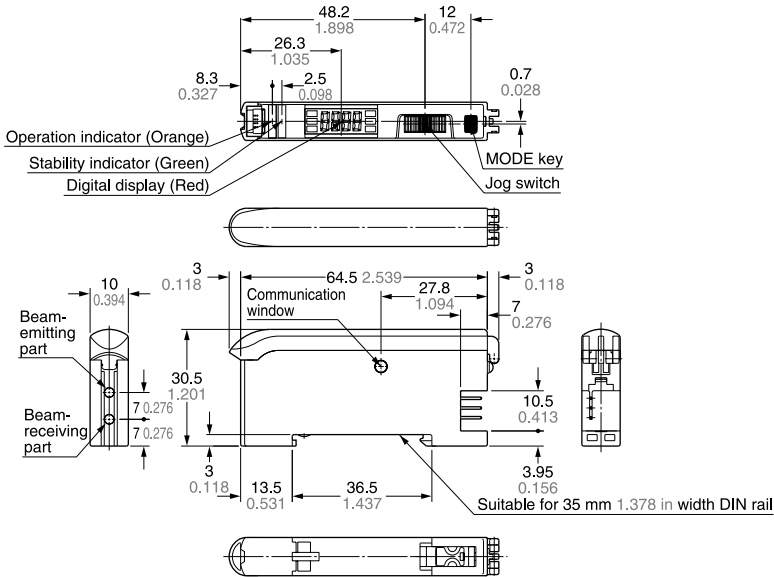




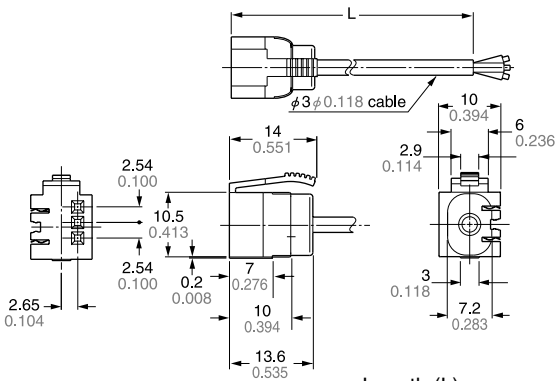
# FX-301

## DIMENSIONS (Unit: mm in)

### FX-301 P FX-301 P Amplifier



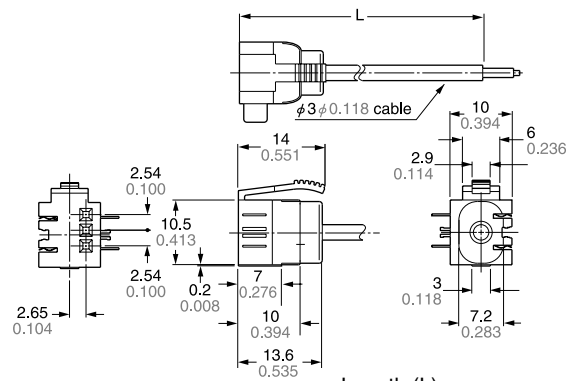
### CN-73-C1 CN-73-C2 CN-73-C5 Main cable (Optional)



• Length (L)

Model No.	Length (mm in)
CN-73-C1	1,000 39.370
CN-73-C2	2,000 78.740
CN-73-C5	5,000 196.850

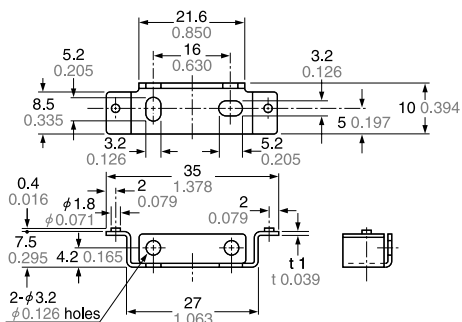
### CN-71-C1 CN-71-C2 CN-71-C5 Sub cable (Optional)



• Length (L)

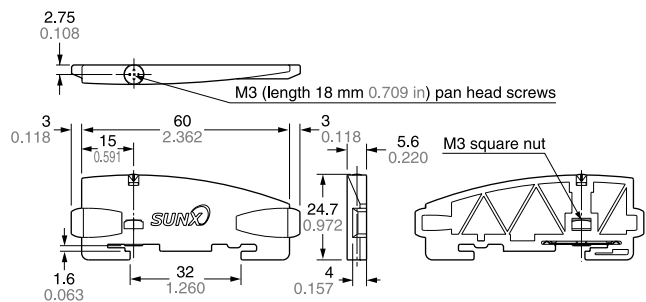
Model No.	Length (mm in)
CN-71-C1	1,000 39.370
CN-71-C2	2,000 78.740
CN-71-C5	5,000 196.850

### MS-DIN-2 Amplifier mounting bracket (Optional)



Material: Cold rolled carbon steel (SPCC)  
(Uni-chrome plated)

### MS-DIN-E End plate (Optional)



Material: Polycarbonate

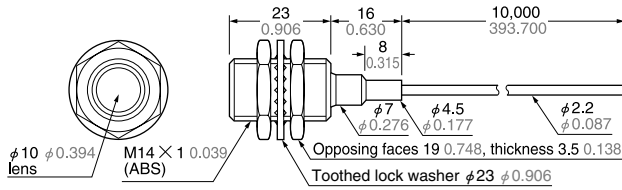
## DIMENSIONS (Unit: mm in)

Thru-beam type fibers

**FT-FM10L**

Free-cut

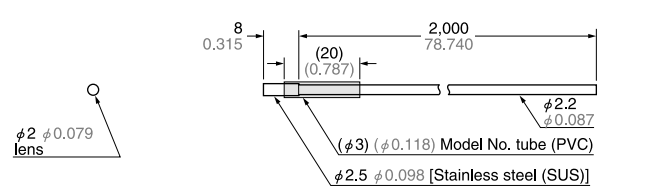
With FX-AT3



**FT-SFM2L**

Free-cut

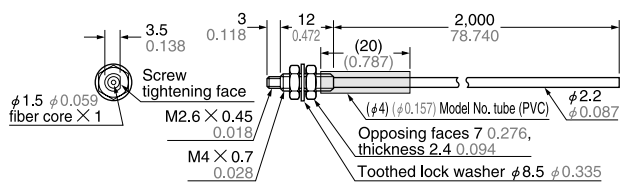
With FX-AT3



**FT-B8**

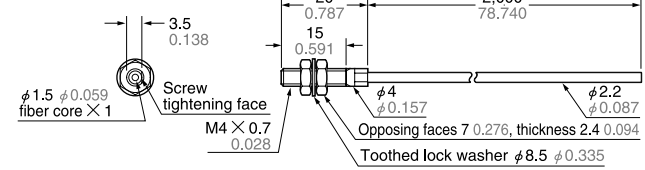
Free-cut

With FX-AT3



**FT-NB8**

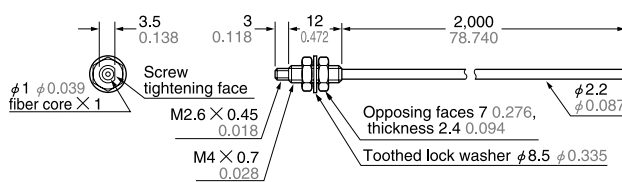
Free-cut



**FT-FM2**

Free-cut

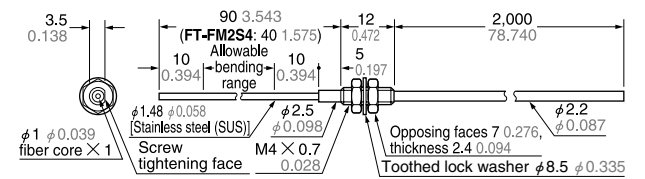
With FX-AT3



**FT-FM2S  
FT-FM2S4**

Free-cut

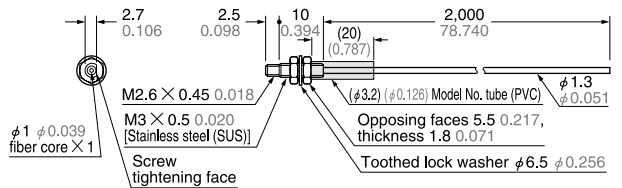
With FX-AT3



**FT-T80**

Free-cut

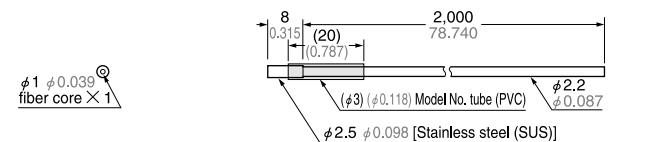
With FX-AT5



**FT-SFM2**

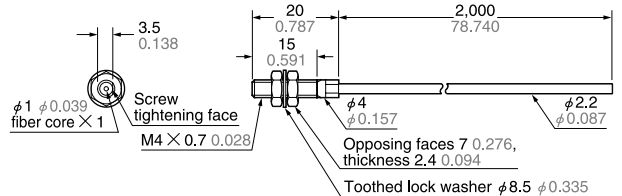
Free-cut

With FX-AT3



**FT-N8**

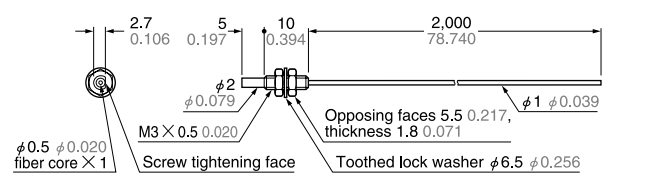
Free-cut



**FT-NFM2**

Free-cut

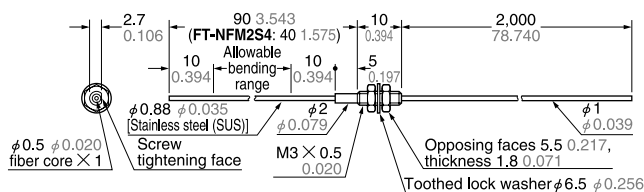
With FX-AT4



**FT-NFM2S  
FT-NFM2S4**

Free-cut

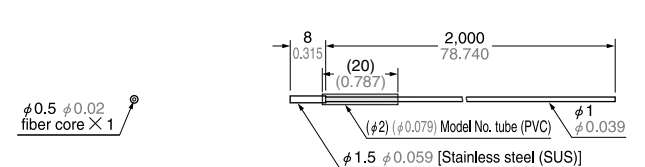
With FX-AT4



**FT-SNFM2**

Free-cut

With FX-AT4



# FX-301

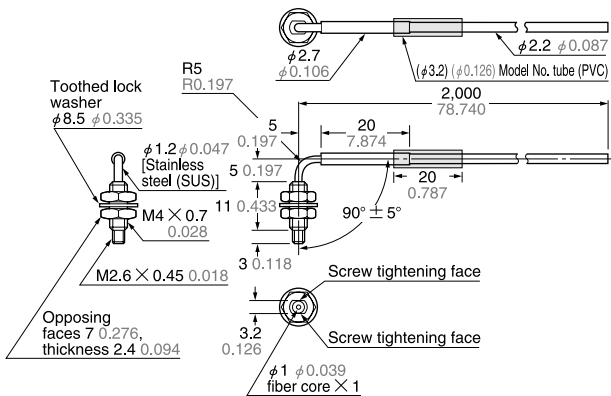
## DIMENSIONS (Unit: mm in)

### Thru-beam type fibers

**FT-R80**

Free-cut

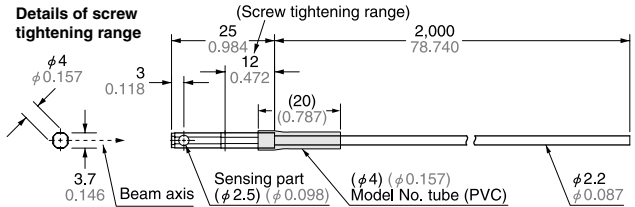
With FX-AT3



**FT-V10**

Free-cut

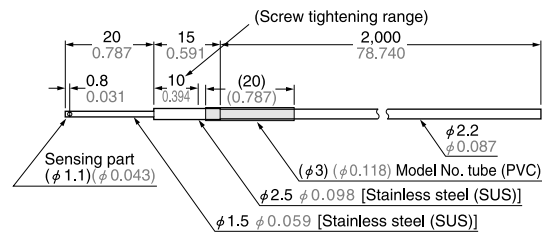
With FX-AT3



**FT-SFM2SV2**

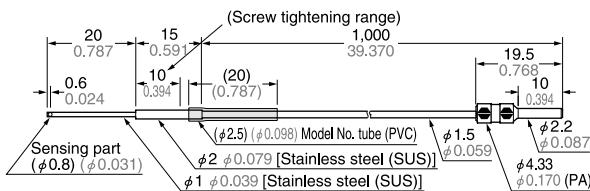
Free-cut

With FX-AT3



**FT-V22**

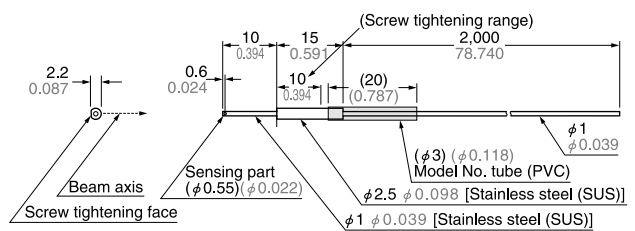
With FX-AT2



**FT-V41**

Free-cut

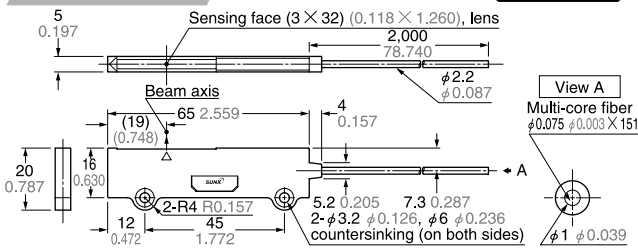
With FX-AT4



**FT-WA30**

Free-cut

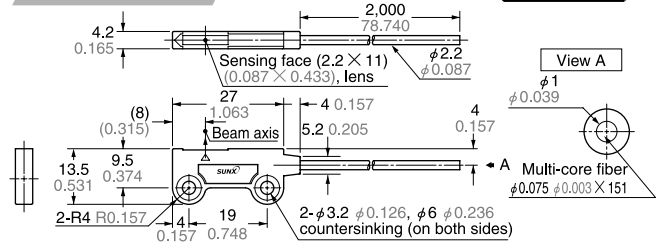
With FX-AT3



**FT-WA8**

Free-cut

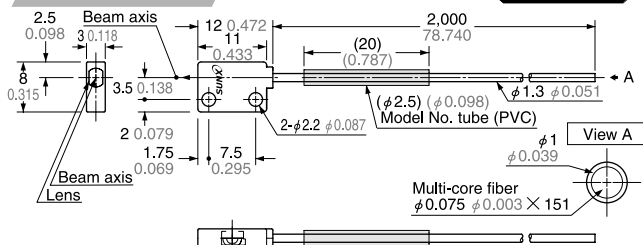
With FX-AT3



**FT-WZ8H**

Free-cut

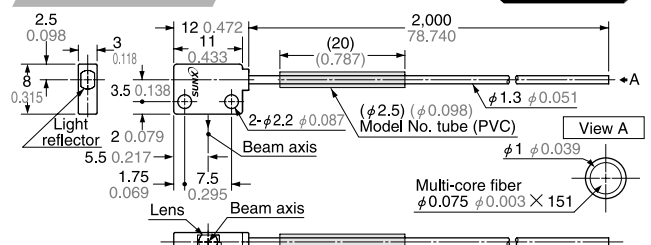
With FX-AT5



**FT-WZ8E**

Free-cut

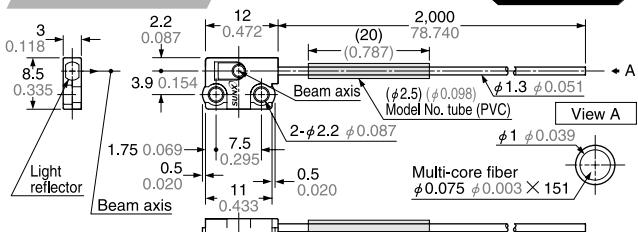
With FX-AT5



**FT-WZ8**

Free-cut

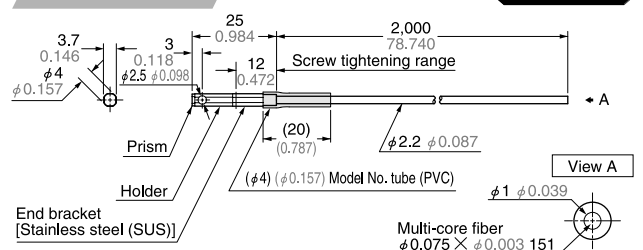
With FX-AT5



**FT-WKV8**

Free-cut

With FX-AT3



Note: The emitter and receiver are symmetric.

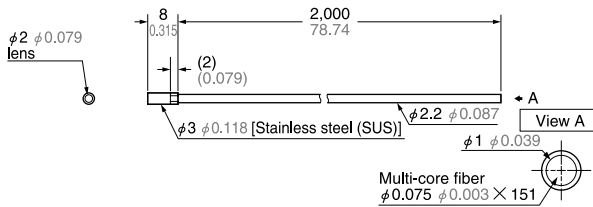
## DIMENSIONS (Unit: mm in)

### Thru-beam type fibers

**FT-WS8L**

Free-cut

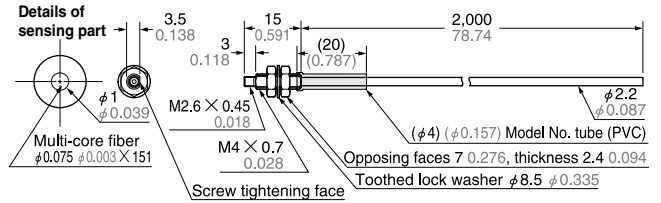
With FX-AT3



**FT-W8**

Free-cut

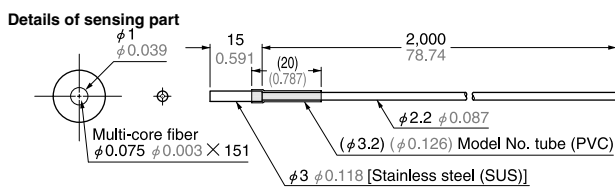
With FX-AT3



**FT-WS3**

Free-cut

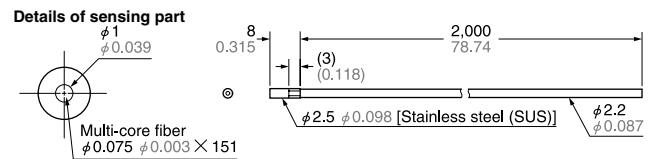
With FX-AT3



**FT-WS8**

Free-cut

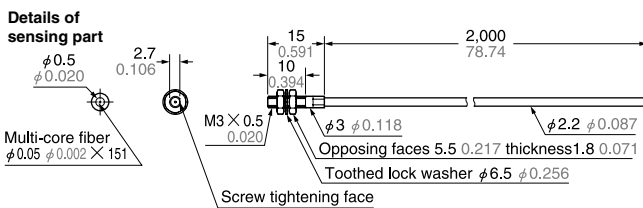
With FX-AT3



**FT-W4**

Free-cut

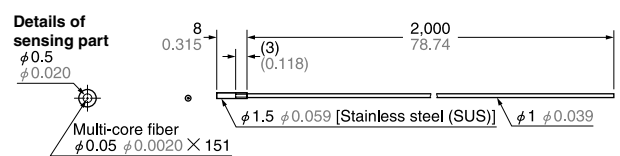
With FX-AT3



**FT-WS4**

Free-cut

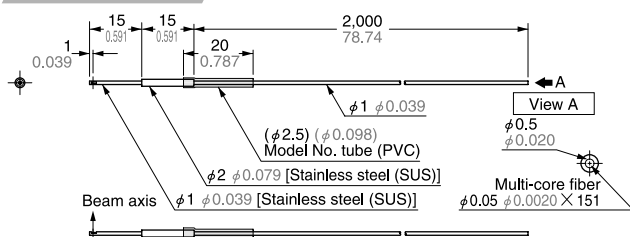
With FX-AT4



**FT-WV42**

Free-cut

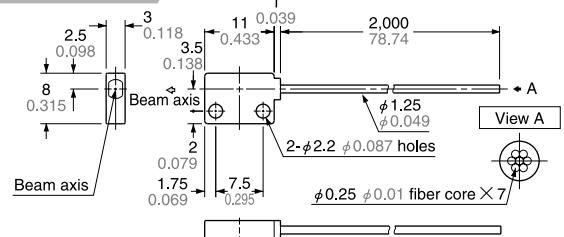
With FX-AT4



**FT-Z8H**

Free-cut

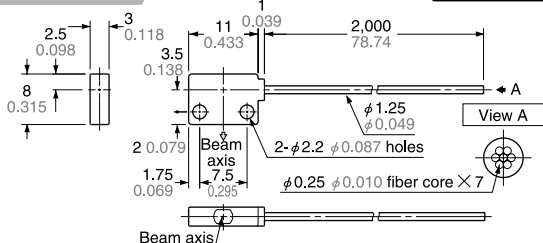
With FX-AT5



**FT-Z8E**

Free-cut

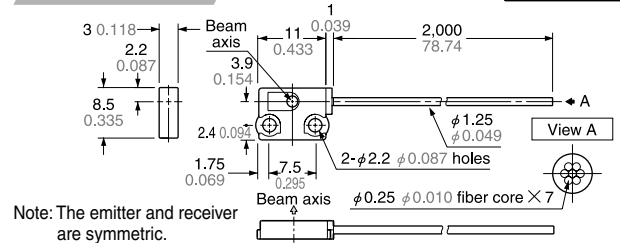
With FX-AT5



**FT-Z8**

Free-cut

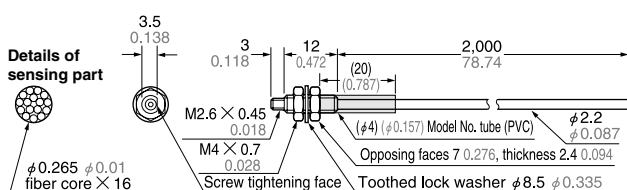
With FX-AT5



Note: The emitter and receiver are symmetric.

**FT-P80**

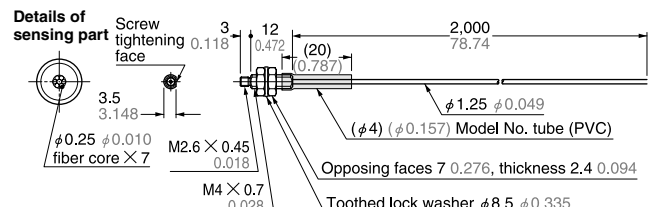
Free-cut



**FT-P60**

Free-cut

With FX-AT5



# FX-301

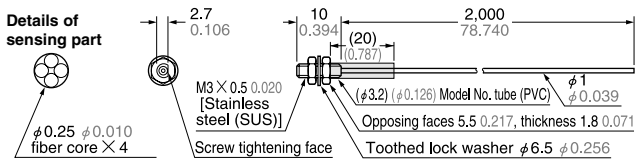
## DIMENSIONS (Unit: mm in)

### Thru-beam type fibers

**FT-P40**

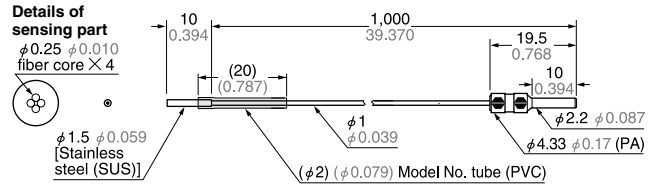
Free-cut

With FX-AT4



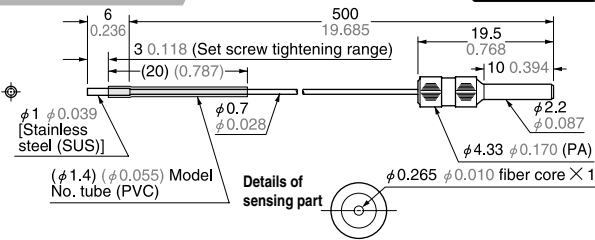
**FT-P2**

With FX-AT2



**FT-PS1**

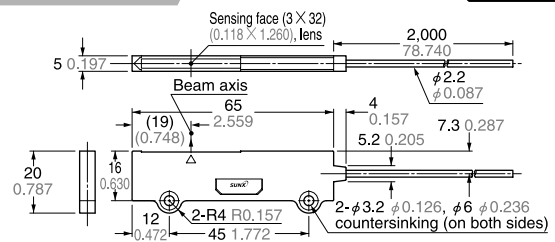
With FX-AT2



**FT-A30**

Free-cut

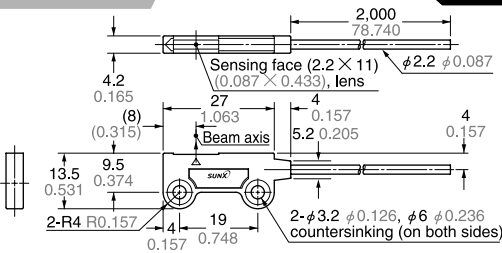
With FX-AT3



**FT-A8**

Free-cut

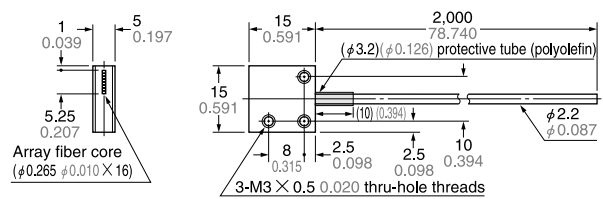
With FX-AT3



**FT-AFM2**

Free-cut

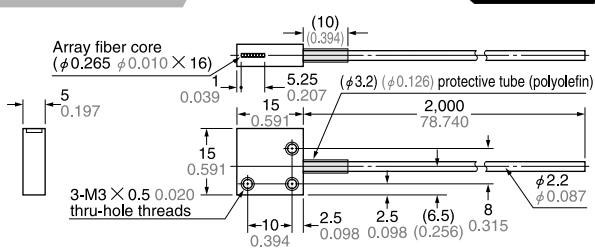
With FX-AT3



**FT-AFM2E**

Free-cut

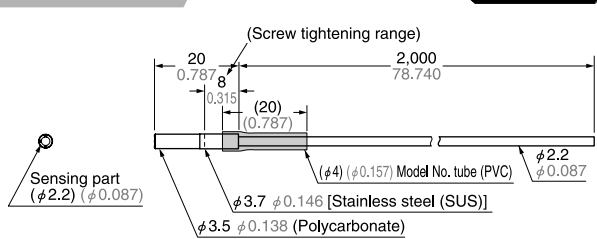
With FX-AT3



**FT-K8**

Free-cut

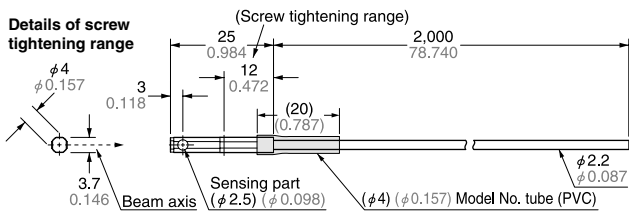
With FX-AT3



**FT-KV8**

Free-cut

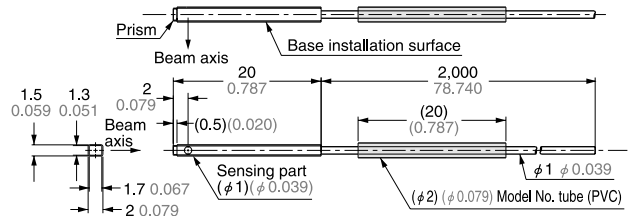
With FX-AT3



**FT-KV1**

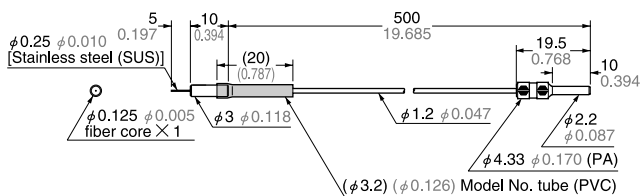
Free-cut

With FX-AT4



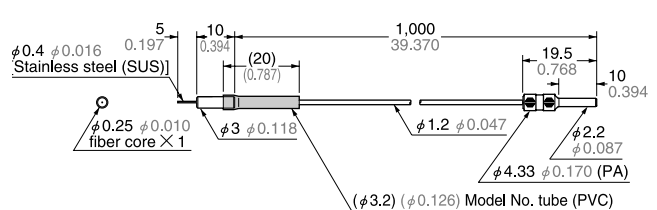
**FT-E12**

With FX-AT2



**FT-E22**

With FX-AT2

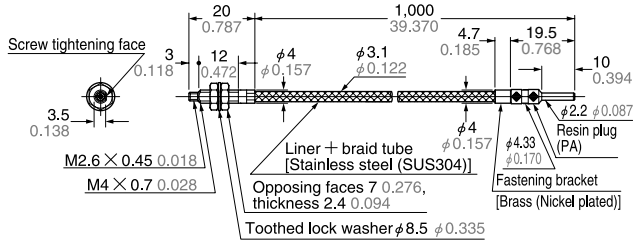


## DIMENSIONS (Unit: mm in)

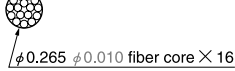
Thru-beam type fibers 

**FT-P81X**

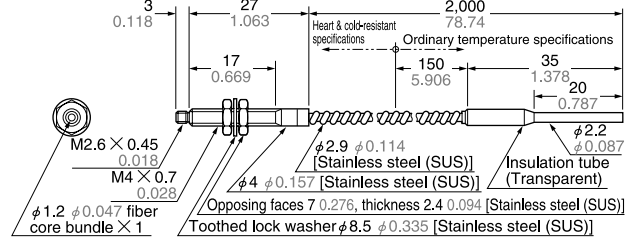
With FX-AT2



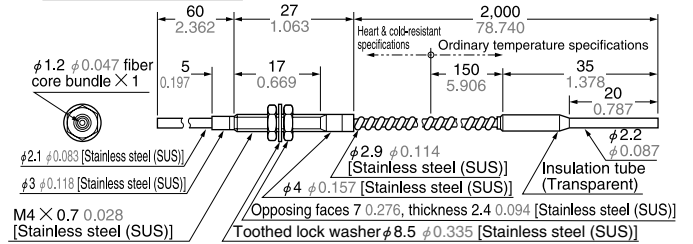
Details of sensing part



**FT-H35-M2**

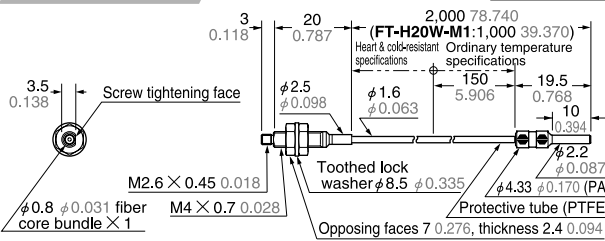


**FT-H35-M2S6**

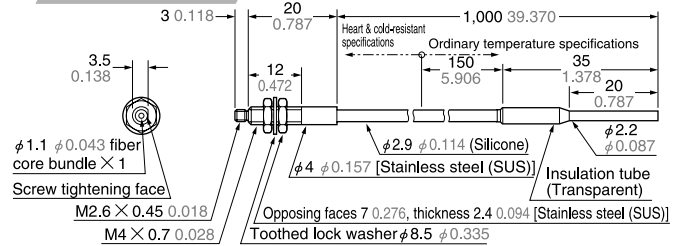


**FT-H20W-M1**  
**FT-H20W-M2**

With FX-AT2



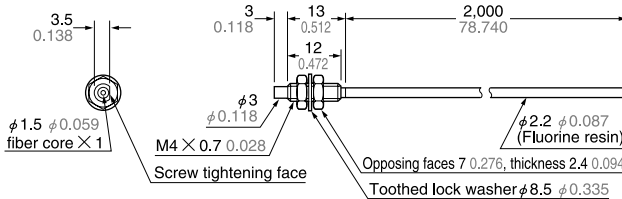
**FT-H20-M1**



**FT-H13-FM2**

Free-cut

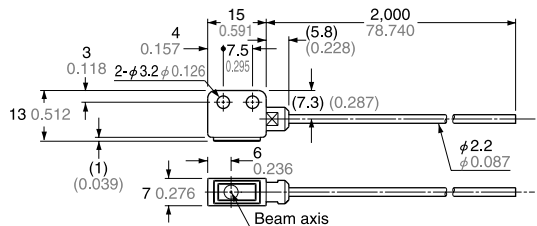
With FX-AT3



**FT-Z802Y**

Free-cut

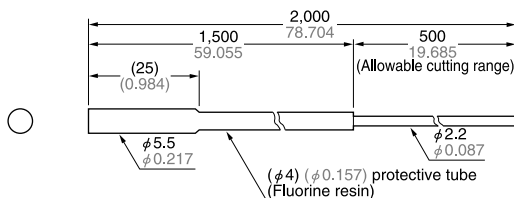
With FX-AT3



**FT-L8Y**

Free-cut

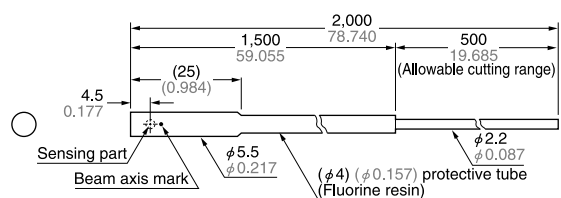
With FX-AT3



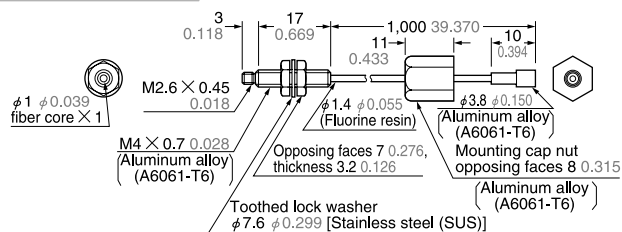
**FT-V8Y**

Free-cut

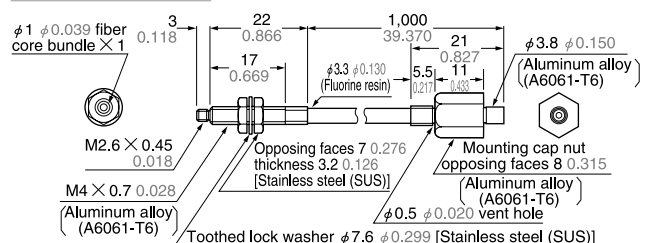
With FX-AT3



**FT-6V**



**FT-60V**



# FX-301

## DIMENSIONS (Unit: mm in)

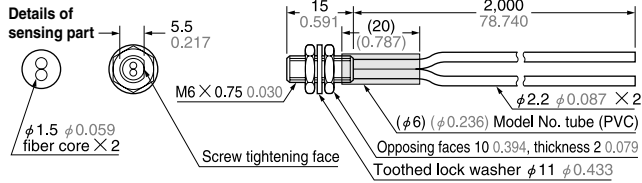
### Reflective type fibers



#### FD-B8

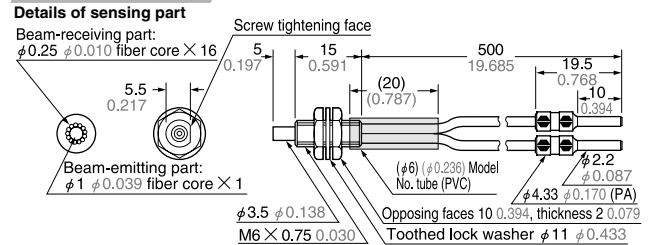
Free-cut

With FX-AT3



#### FD-5

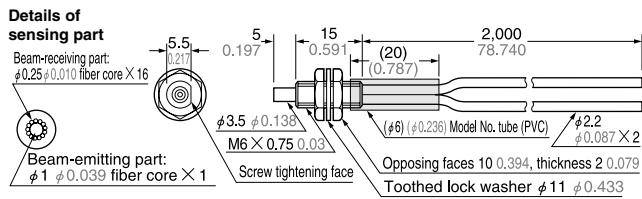
With FX-AT2



#### FD-FM2

Free-cut

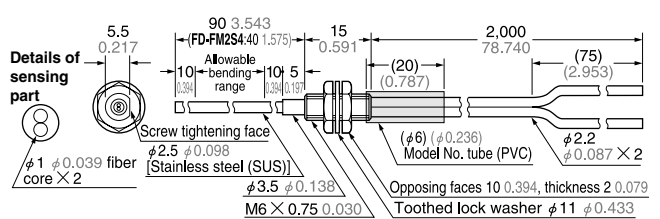
With FX-AT3



#### FD-FM2S FD-FM2S4

Free-cut

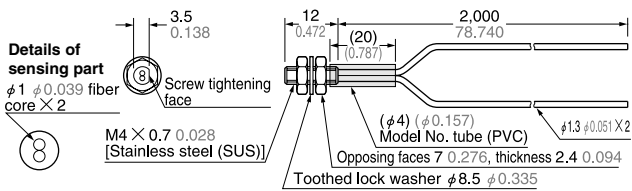
With FX-AT3



#### FD-T80

Free-cut

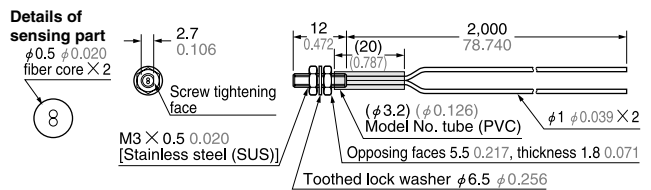
With FX-AT5



#### FD-T40

Free-cut

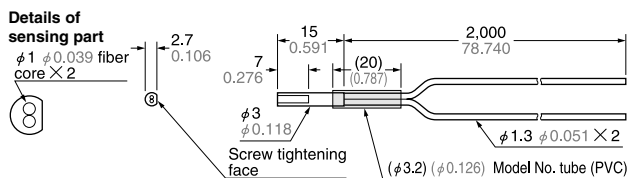
With FX-AT4



#### FD-S80

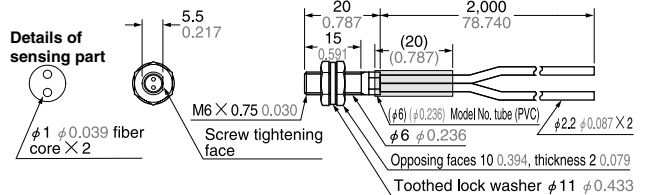
Free-cut

With FX-AT5



#### FD-N8

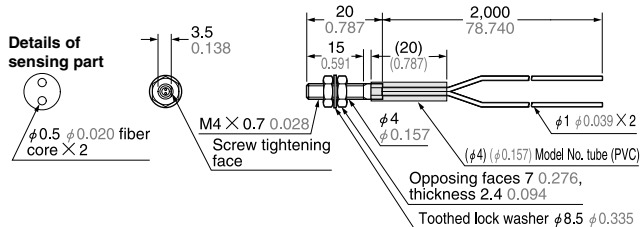
Free-cut



#### FD-N4

Free-cut

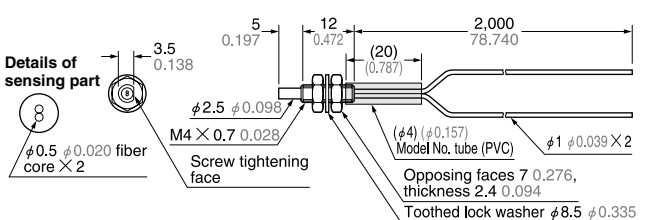
With FX-AT10



#### FD-NFM2

Free-cut

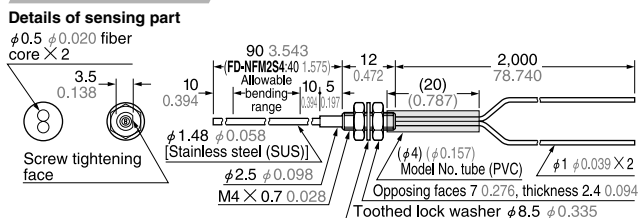
With FX-AT4



#### FD-NFM2S FD-NFM2S4

Free-cut

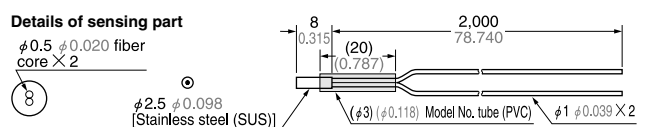
With FX-AT4



#### FD-SNFM2

Free-cut

With FX-AT4



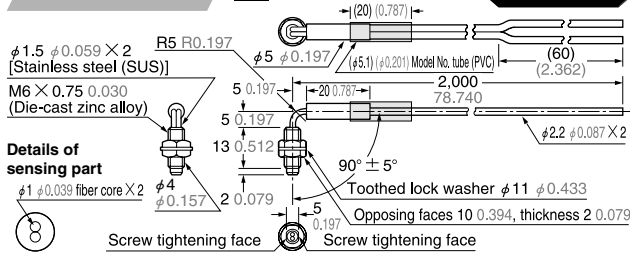
## DIMENSIONS (Unit: mm in)

### Reflective type fibers

#### FD-R80

Free-cut

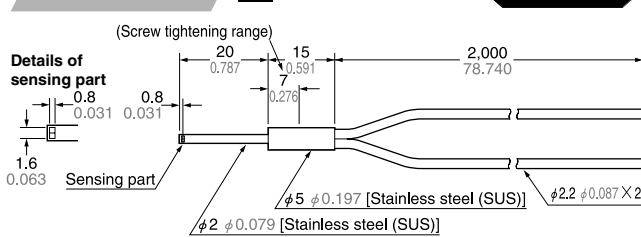
With FX-AT3



#### FD-SFM2SV2

Free-cut

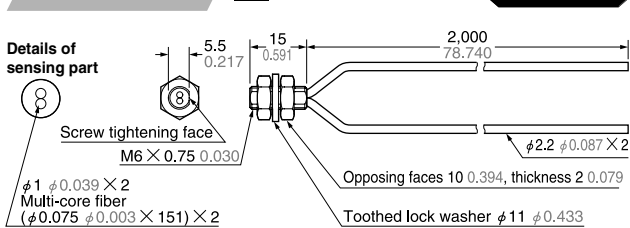
With FX-AT3



#### FD-W8

Free-cut

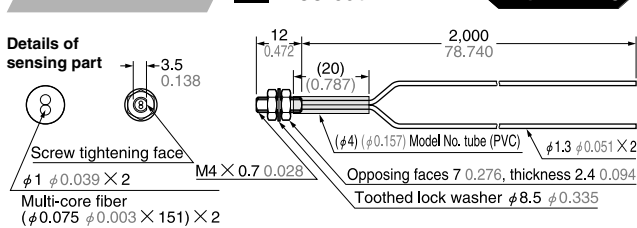
With FX-AT3



#### FD-WT8

Free-cut

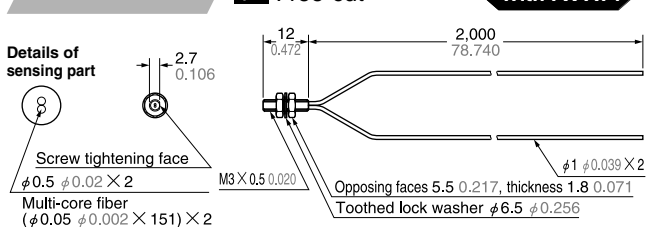
With FX-AT5



#### FD-WT4

Free-cut

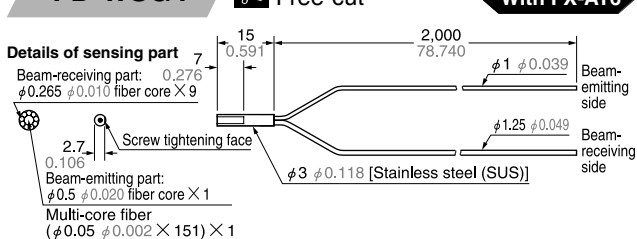
With FX-AT4



#### FD-WSG4

Free-cut

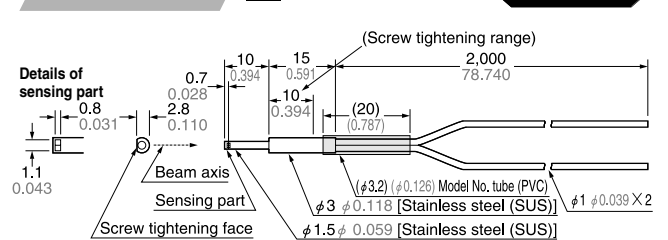
With FX-AT6



#### FD-V41

Free-cut

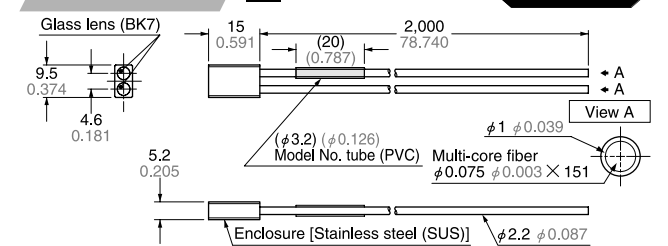
With FX-AT4



#### FD-WKZ1

Free-cut

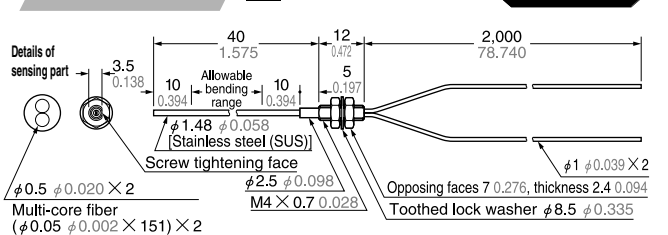
With FX-AT3



#### FD-W44

Free-cut

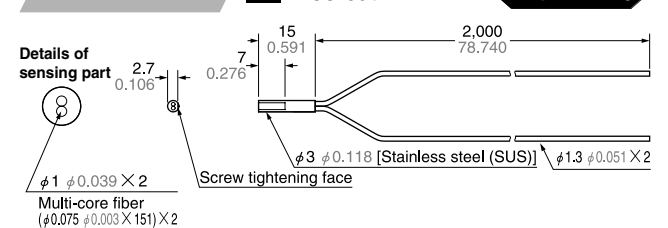
With FX-AT4



#### FD-WS8

Free-cut

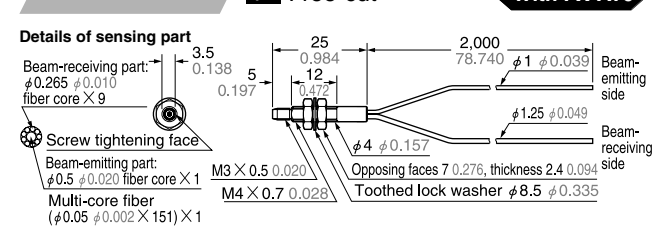
With FX-AT5



#### FD-WG4

Free-cut

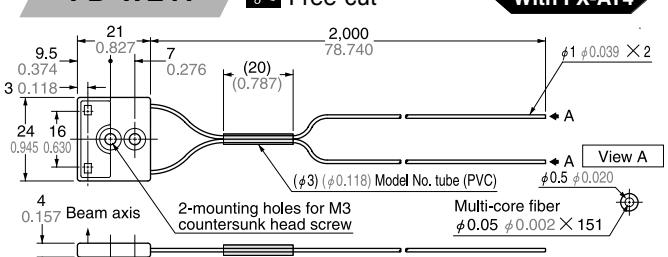
With FX-AT6



#### FD-WL41

Free-cut

With FX-AT4

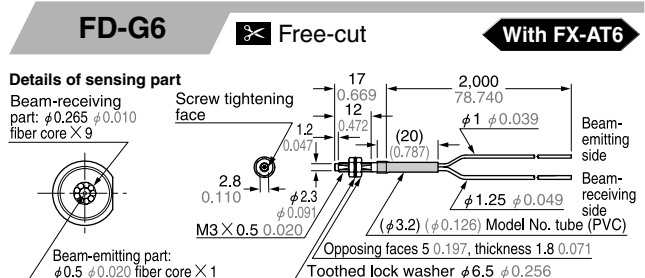
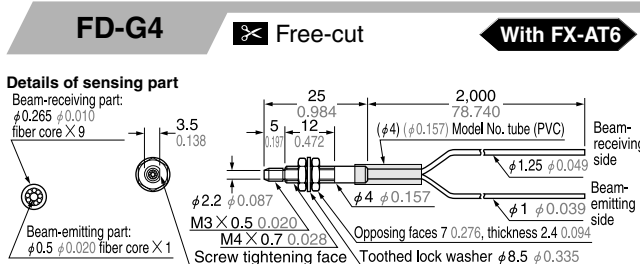
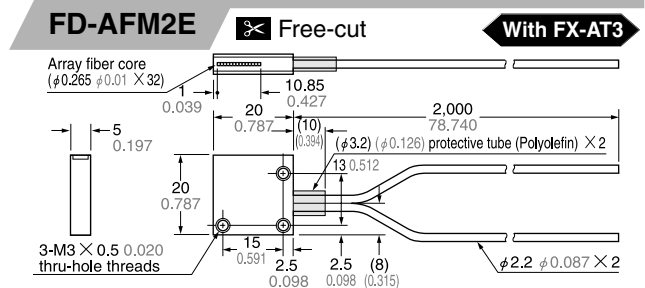
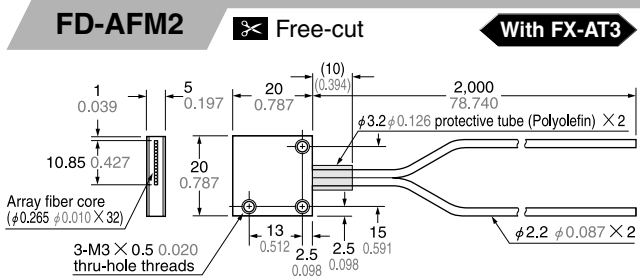
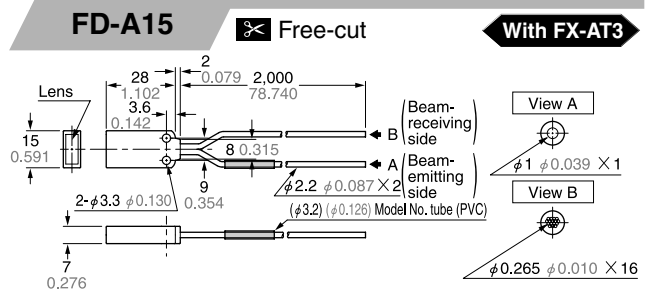
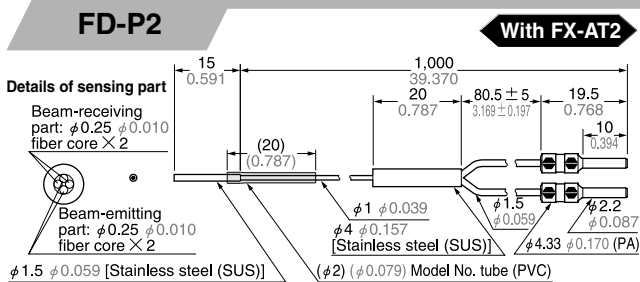
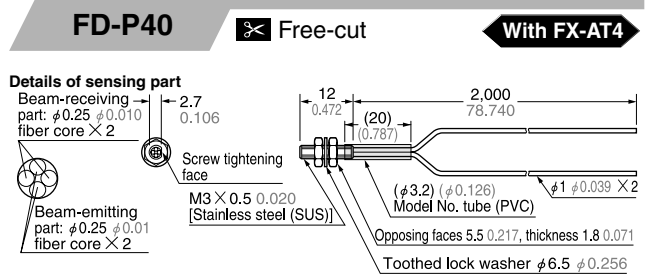
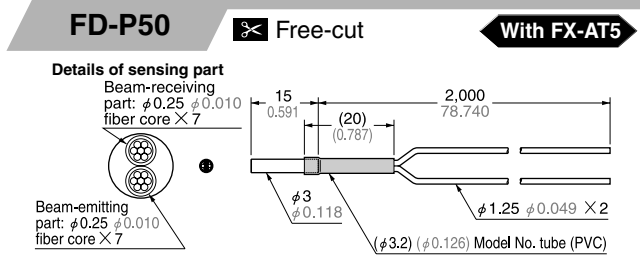
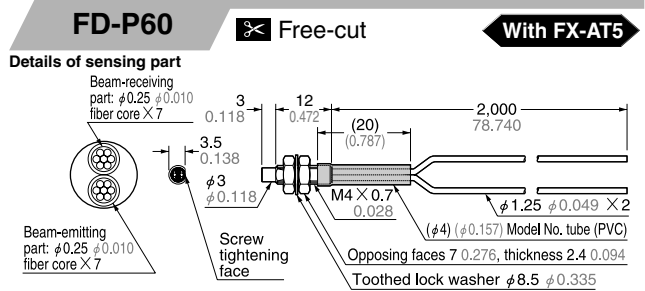
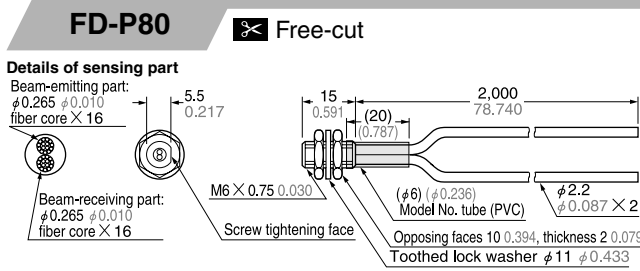
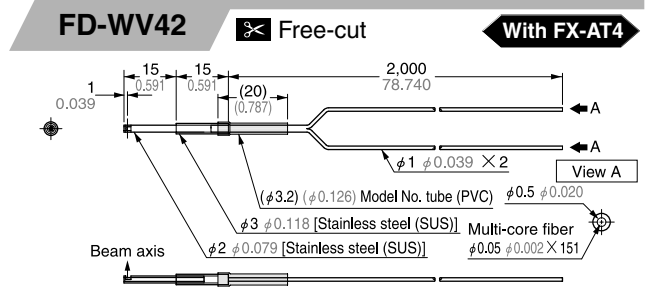
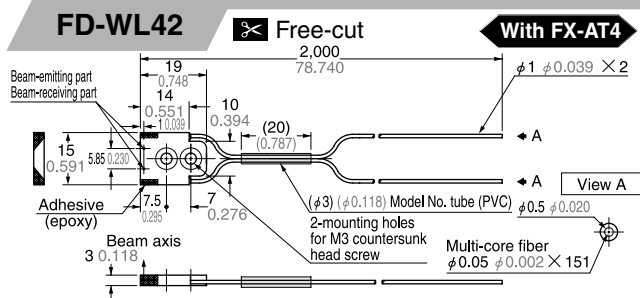




# FX-301

## DIMENSIONS (Unit: mm in)

### Reflective type fibers



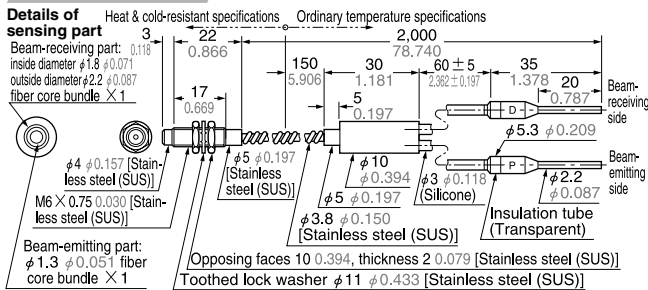




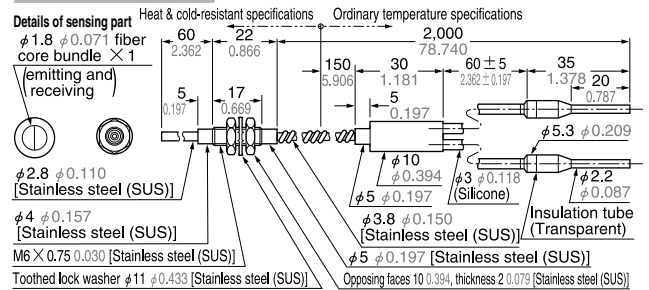
## DIMENSIONS (Unit: mm in)

### Reflective type fibers

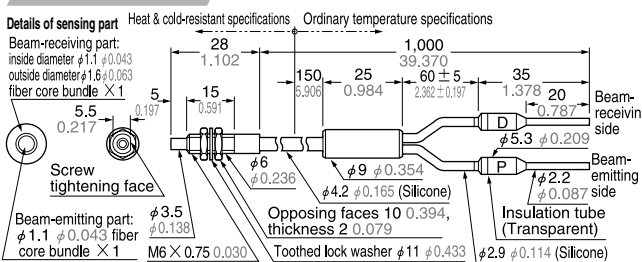
#### FD-H35-M2



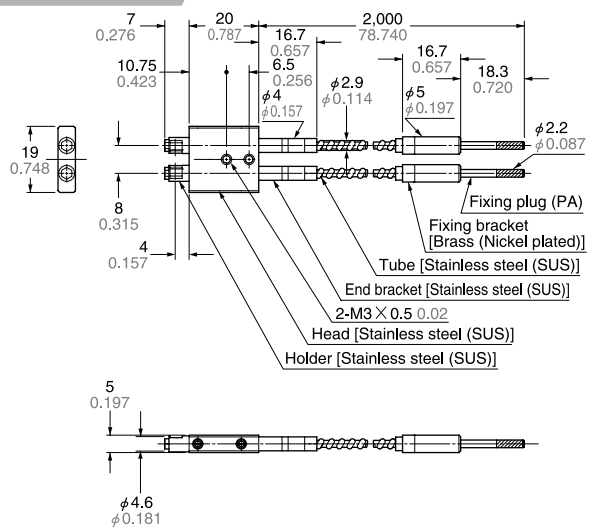
#### FD-H35-M2S6



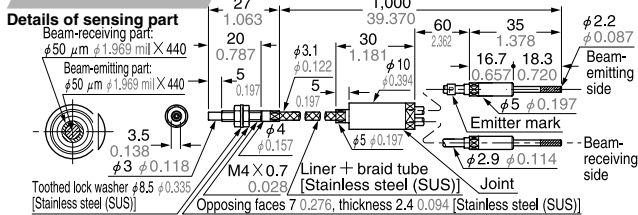
#### FD-H20-M1



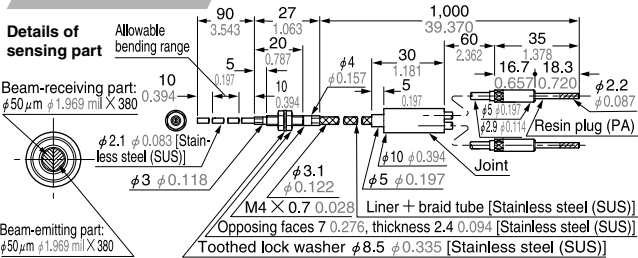
#### FD-H30-L32



#### FD-H20-21



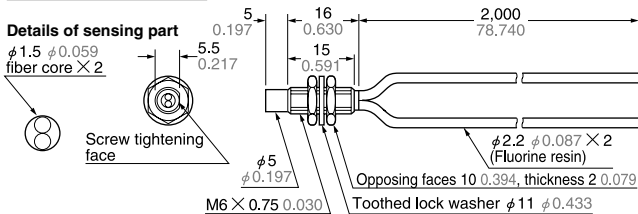
#### FD-H35-20S



#### FD-H13-FM2

Free-cut

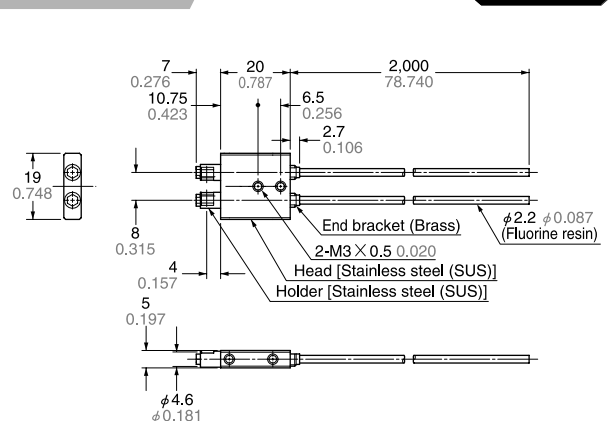
With FX-AT3



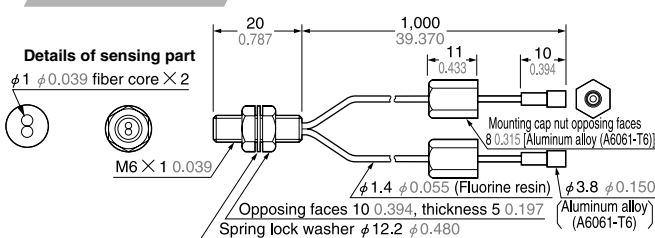
#### FD-H18-L31

Free-cut

With FX-AT3

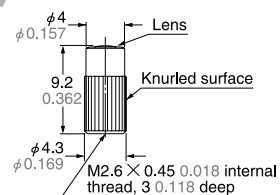


#### FD-6V



#### FX-LE1

Expansion lens (Optional)

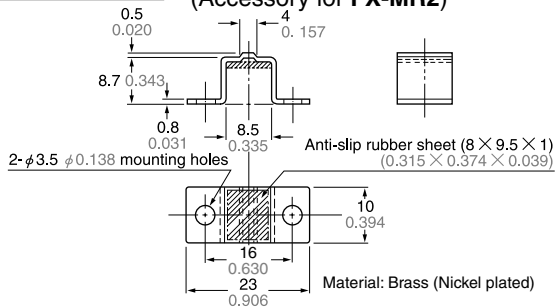


Material: Enclosure .....Brass (Nickel plated)  
Lens .....Glass

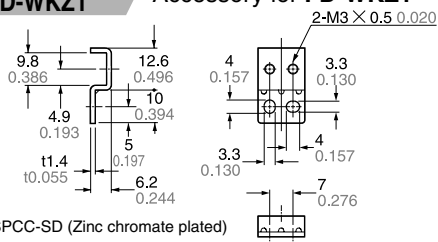


## DIMENSIONS (Unit: mm in)

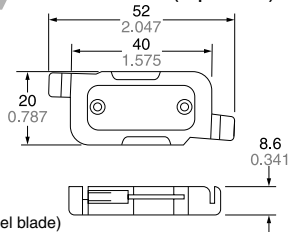
### MS-EX-3 Mounting bracket for FX-MR2 (Accessory for FX-MR2)



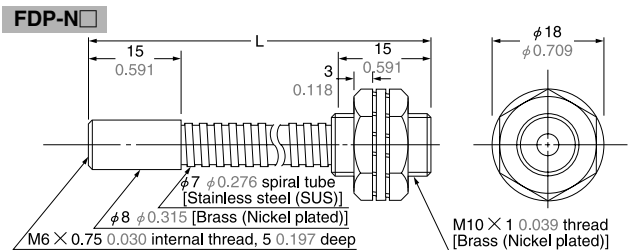
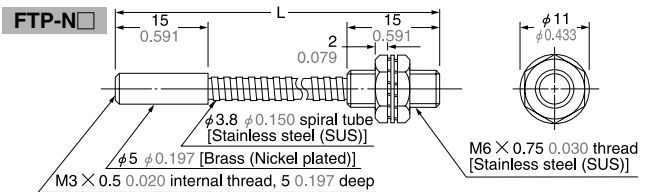
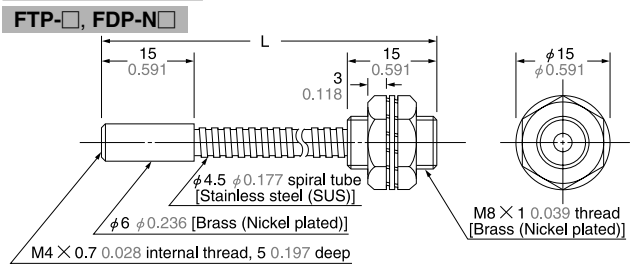
### Mounting bracket for FD-WKZ1 (Accessory for FD-WKZ1)



### FB-1 Fiber bender (Optional)



### FTP-□ FDP-□ Protective tube (Optional)



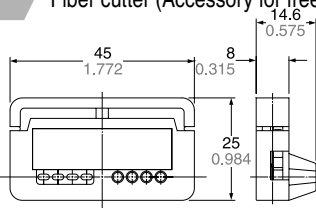
Model No.	Length L (mm in)
FTP-500, FTP-N500, FDP-N500, FDP-500	500 + <sup>10</sup> <sub>0</sub> 19.685 + <sup>0.394</sup> <sub>0</sub>
FTP-1000, FTP-N1000, FDP-N1000, FDP-1000	1,000 + <sup>10</sup> <sub>0</sub> 39.37 + <sup>0.394</sup> <sub>0</sub>
FTP-1500, FTP-N1500, FDP-N1500, FDP-1500	1,500 + <sup>10</sup> <sub>0</sub> 59.055 + <sup>0.394</sup> <sub>0</sub>

### FX-CT2 Fiber cutter (Accessory for free-cut type fiber)

FX-CT2 is not attached with the FT-NB8/N8/P80 or the FD-N8/N4/P80

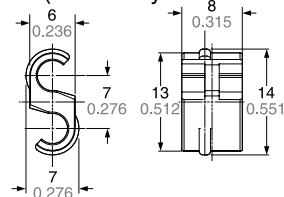
A conventional FX-CT1 fiber cutter is attached with the FT-P80 and the FD-P80.

Material: ABS



### FX-AT2 Attachment for fixed-length fiber (Accessory for fixed-length fiber)

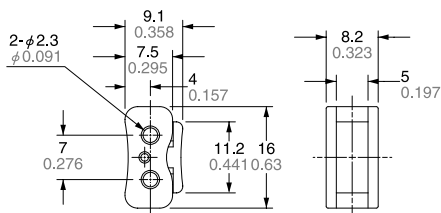
Material: POM



### FX-AT3 Attachment for φ2.2 mm φ0.087 in fiber (Accessory)

FX-AT3 is not attached with the FT-NB8/N8/P80, FD-N8/P80

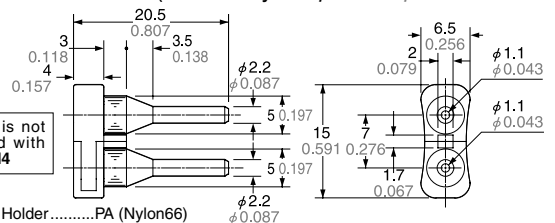
Material: Polycarbonate



### FX-AT4 Attachment for φ1 mm φ0.039 in fiber (Accessory for φ1 mm φ0.039 in fiber)

FX-AT4 is not attached with the FD-N4

Materials: Holder.....PA (Nylon66)  
Ground.....POM



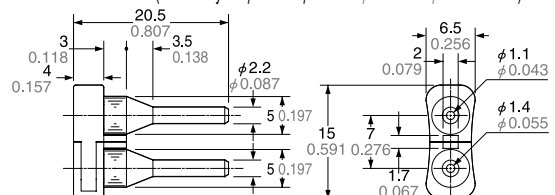
### FX-AT5 Attachment for φ1.3 mm φ0.051 in fiber (Accessory for φ1.3 mm φ0.051 in fiber)

Materials: Holder.....PA (Nylon66)  
Ground.....POM



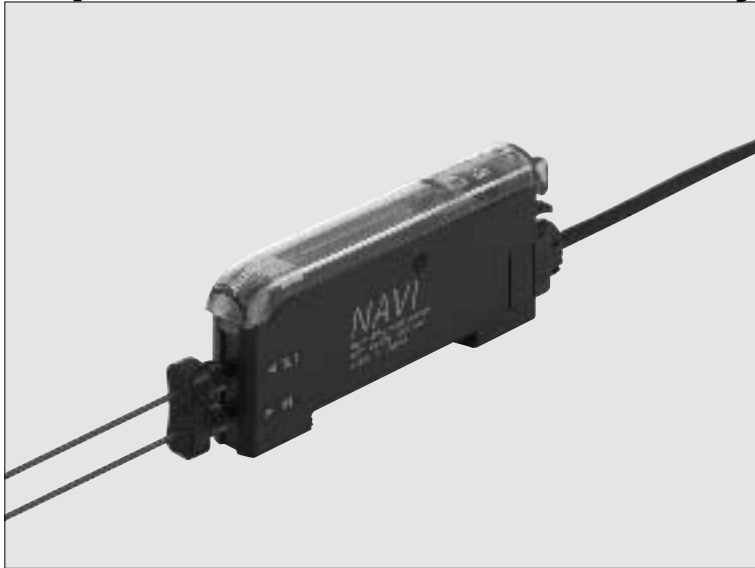
### FX-AT6 Attachment for φ1 mm / φ1.3 mm φ0.039 in / φ0.051 in mixed fiber (Accessory for φ1 mm / φ1.3 mm φ0.039 in / φ0.051 in fiber)

Materials: Holder.....PA (Nylon66)  
Ground.....POM



# FX-301-F

## Digital Fiber Sensor for Leak Detection / Liquid Detection Fibers Only



**Easy operation even for beginners!  
Optimum settings can be realized with simple operations**

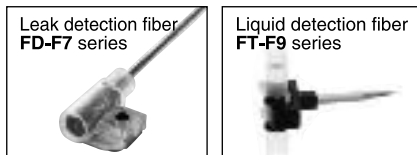
\* Passed the UL 991 Environment Test

\* UL 61010C-1 compatible, Passed the UL 991 Environment Test based on SEMI S2-0200.  
[Category applicable for semiconductor manufacturing: TWW2, Process Equipment]  
[Applicable standards: UL 61010C-1]  
[Additional test / evaluation standards as per intended use: UL991, SEMI S2-0200]



### For use with leak detection or liquid detection fiber only

FX-301-F is designed specifically for use with the leak detection fiber (FD-F7 series) or the liquid detection fiber (FT-F9 series). You can easily set the optimum conditions.



FX-301(P)-F



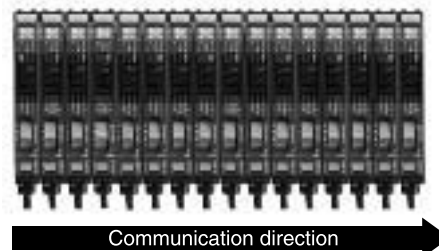
### Easy to operate with individual / collective teaching mode

#### Individual teaching mode (TEACH)

After you select the FD-F7 series or the FT-F9 series with the jog switch, the optimum threshold level is automatically set by just pressing the jog switch.

#### Collective teaching mode (ALL)

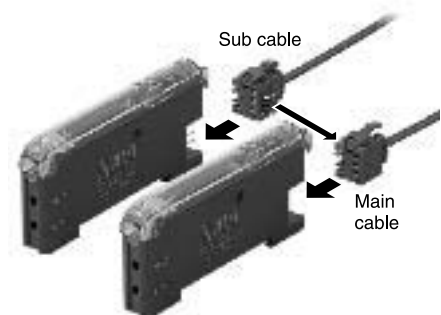
You can set the optimum sensitivity for all cascaded units in one step by the optical communications function. Moreover, since the settings are also copied to all units, the time involved is considerably reduced.



Collective teaching mode is possible for 16 units max.

### Easy maintenance, as main and sub units are identical

Both main and sub units utilize the same amplifier body. This feature allows for easy mounting in the side-by-side configuration. The main and sub unit functions are distinguished only by the proper use of 3-core main cable and the 1-core sub cable. Moreover, by utilizing the same body for both main and sub units, inventory management and maintenance is simplified.



### Flashing function incorporated

When the leak detection fiber is connected (F7 mode), if a leak is detected, you will recognize which fiber detects the leak at a single glance because the emitter will start flashing.

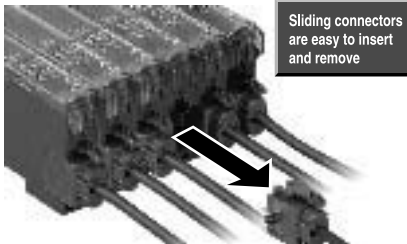
### Long life and stable operational settings assure dependable performance

FX-301(P)-F incorporates our newly developed 'four-chemical emitting element', which eliminates such LED performance deterioration. This new element results in stable incident light levels that can be maintained almost indefinitely.

# FX-301-F

## Wiring- and labor-saving design allows side-by-side configuration for up to sixteen units

Up to sixteen amplifiers can be connected in a side-by-side configuration. As the sub cable contains only one output line, a great amount of wiring and space can be saved. Also, special 'sliding' connectors have been provided for all main and sub cables, which can be detached merely by releasing the lock and pulling directly back, without having to slide the main amplifier body to the side. Using this connector system, only a minimal amount of space is required for regular maintenance.



## Easy operation with MODE NAVI

MODE NAVI uses six indicators to display the amplifier's basic operations.

The current operating mode can be confirmed at a glance, so even a first time user can easily operate the amplifier without becoming confused.



MODE NAVI (MODE indicators)

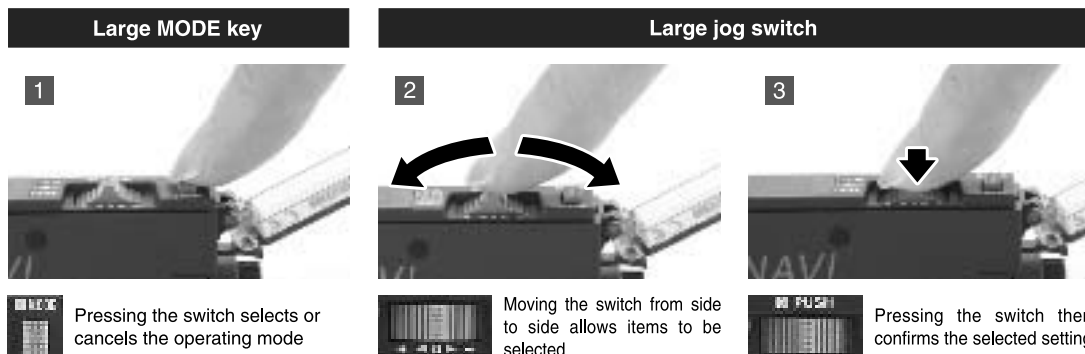
## Simple operation with easy access to advanced functions

Each mode can be selected using the large MODE key. Detailed functions and settings can be chosen using the large jog switch. Each setting mode can be easily confirmed by viewing the MODE indicator display.

The advanced features available in each mode can be easily viewed and smoothly selected from the digital display.

## Two switches with distinct functions

Only two switches, the large jog switch and the large MODE key, are required for operation. Depressing the large MODE key sets the 'mode selection' and 'mode cancel' functions. The large jog switch is used to select from the detailed functions available within each mode, as well as to change numerical values after the mode has been chosen. The use of only two switches makes for very simple operations and easy maintenance.



## ORDER GUIDE

### Amplifiers **Quick-connection cable is not supplied with the amplifier. Please order it separately.**

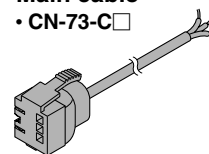
Type	Appearance	Model No.	Emitting element	Output
NPN output		<b>FX-301-F</b>	Red LED	NPN open-collector transistor
PNP output		<b>FX-301P-F</b>		PNP open-collector transistor

### Quick-connection cables **Quick-connection cable is not supplied with the amplifier. Please order it separately.**

Type	Model No.	Description
Main cable	<b>CN-73-C1</b>	Length: 1 m 3.281 ft
	<b>CN-73-C2</b>	Length: 2 m 6.562 ft
	<b>CN-73-C5</b>	Length: 5 m 16.404 ft
Sub cable	<b>CN-71-C1</b>	Length: 1 m 3.281 ft
	<b>CN-71-C2</b>	Length: 2 m 6.562 ft
	<b>CN-71-C5</b>	Length: 5 m 16.404 ft

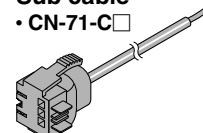
#### Main cable

• **CN-73-C**



#### Sub cable

• **CN-71-C**

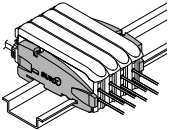




# FX-301-F

## ORDER GUIDE

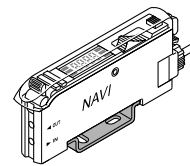
**End plates** End plates are not supplied with the amplifier. Please order it separately when the amplifiers are mounted in cascade.

Appearance	Model No.	Description
	<b>MS-DIN-E</b>	When cascading multiple amplifiers, or when it moves depending on the way it is installed on a DIN rail, these end plates ensure that all amplifiers are mounted together in a secure and fully connected manner. <b>Two pcs. per set</b>

## OPTIONS

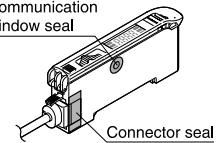
Designation	Model No.	Description
Amplifier mounting bracket	<b>MS-DIN-2</b>	Mounting bracket for amplifier
Fiber sensor amplifier protection seal	<b>FX-MB1</b>	10 sets of 2 communication window seals and 1 connector seal Communication window seal: It prevents malfunction due to transmission signal from another amplifier, as well as, prevents effect on another amplifier. Connector seal: It prevents contact of any metal, etc., with the pins of the quick-connection cable.

**Amplifier mounting bracket**  
• **MS-DIN-2**



**Fiber sensor amplifier protection seal**  
• **FX-MB1**

Communication window seal



## SPECIFICATIONS

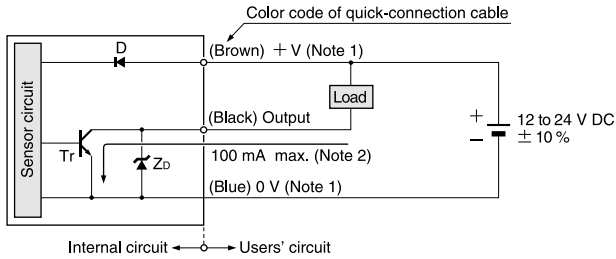
Item	Type	NPN output	PNP output
	Model No.	<b>FX-301-F</b>	<b>FX-301P-F</b>
Applicable fibers		<b>FD-F7 series, FT-F9 series</b>	
Supply voltage		12 to 24 V DC $\pm 10\%$ Ripple P-P 10% or less	
Power consumption		Normal operation: 960 mW or less (Current consumption 40 mA or less at 24 V supply voltage) ECO mode: 600 mW or less (Current consumption 25 mA or less at 24 V supply voltage)	
Output		NPN open-collector transistor • Maximum sink current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less [at 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) sink current]	PNP open-collector transistor • Maximum source current: 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) • Applied voltage: 30 V DC or less (between output and + V) • Residual voltage: 1.5 V or less [at 100 mA (50 mA, if five, or more, amplifiers are connected in cascade.) source current]
	Output operation	Leak setting (F7 mode): OFF with detection of leak, Liquid setting (F9 mode): Using the jog switch, choose the signal OFF condition between absence of liquid and presence of liquid.	
	Short-circuit protection	Incorporated	
Response time		250 $\mu$ s or less (Note 1)	
Sensitivity setting		Individual teaching / Collective teaching	
Operation indicator		Orange LED (lights up when the output is ON)	
Model indicator		Green LED [lights up during liquid setting (F9 mode)]	
MODE indicator		RUN: Green LED, TEACH · ALL · ADJ · DISP · OUT: Yellow LED	
Digital display		4 digit red LED display	
Fine sensitivity adjustment function		Incorporated	
Timer function		Delay timer [used only for liquid setting (F9 mode)] (Timer setting selectable from 10 ms, 100 ms, 1,000 ms, and none)	
Environmental resistance	Ambient temperature	0 to + 50 °C + 32 to + 122 °F (If 8 to 16 units are connected in cascade: 0 to + 45 °C + 32 to + 113 °F (No dew condensation), Storage: - 20 to + 70 °C - 4 to + 158 °F	
	Ambient humidity	35 to 85 % RH, Storage: 35 to 85 % RH	
	Ambient illuminance	Sunlight: 10,000 lx at the light-receiving face, Incandescent light: 3,000 lx at the light-receiving face	
	EMC	EN 50081-2, EN 50082-2, EN 60947-5-2	
	Voltage withstandability	1,000 V AC for one min. between all supply terminals connected together and enclosure (Note 2)	
	Insulation resistance	20 M $\Omega$ , or more, with 250 V DC megger between all supply terminals connected together and enclosure (Note 2)	
	Vibration resistance	10 to 150 Hz frequency, 0.75 mm 0.030 in amplitude in X, Y and Z directions for two hours each	
Shock resistance	98 m/s <sup>2</sup> acceleration (10 G approx.) in X, Y and Z directions for five times each		
Emitting element		Red LED (modulated)	
Material		Enclosure: Heat-resistant ABS, Case cover: Polycarbonate, Switch: Acrylic	
Connecting method		Connector (Note 3)	
Cable extension		Extension up to total 100 m 328.084 ft is possible with 0.3 mm <sup>2</sup> , or more, cable.	
Weight		20 g approx.	

Notes: 1) When detecting leak (output OFF) during leak setting (F7 mode), since the sensor flashes the emitted light, only the response action for turning the signal back to ON is delayed (1 sec. approx.).  
2) The voltage withstandability and the insulation resistance values given in the above table are for the amplifier only.  
3) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cable given below.  
Main cable (3-core): **CN-73-C1** (cable length 1 m 3.281 ft), **CN-73-C2** (cable length 2 m 6.562 ft), **CN-73-C5** (cable length 5 m 16.404 ft)  
Sub cable (1-core): **CN-71-C1** (cable length 1 m 3.281 ft), **CN-71-C2** (cable length 2 m 6.562 ft), **CN-71-C5** (cable length 5 m 16.404 ft)

## I/O CIRCUIT AND WIRING DIAGRAMS

### FX-301-F NPN output type

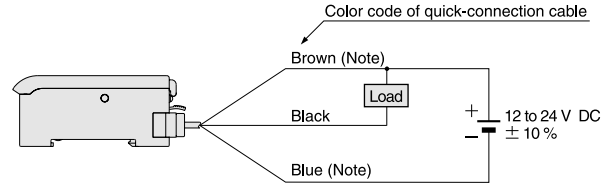
#### I/O circuit diagram



- Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue).  
 2) 50 mA max., if five amplifiers, or more, are connected in cascade.  
 3) Never connect several amplifiers in series (AND).

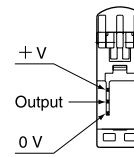
Symbols ... D : Reverse supply polarity protection diode  
 Zd: Surge absorption zener diode  
 Tr: NPN output transistor

#### Wiring diagram



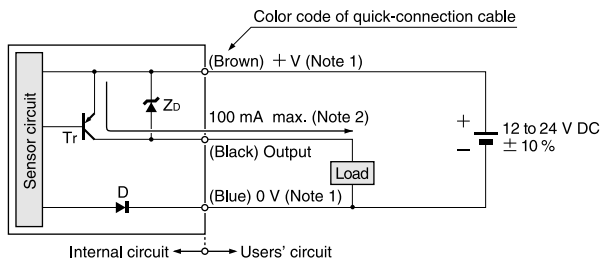
Note: The quick-connection sub cable does not have brown lead wire and blue lead wire.

#### Terminal arrangement diagram



### FX-301P-F PNP output type

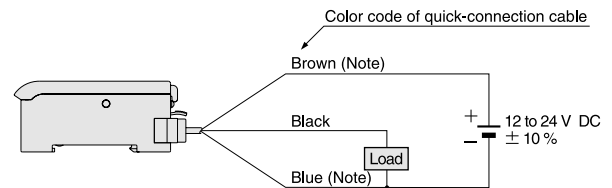
#### I/O circuit diagram



- Notes: 1) The quick-connection sub cable does not have + V (brown) and 0 V (blue).  
 2) 50 mA max., if five amplifiers, or more, are connected in cascade.  
 3) Never connect several amplifiers in series (AND).

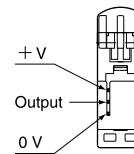
Symbols ... D : Reverse supply polarity protection diode  
 Zd: Surge absorption zener diode  
 Tr: PNP output transistor

#### Wiring diagram



Note: The quick-connection sub cable does not have brown lead wire and blue lead wire.

#### Terminal arrangement diagram



# FX-301-F

## PRECAUTIONS FOR PROPER USE

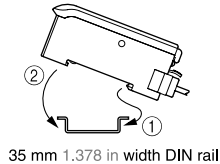


This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.

### Mounting

#### How to mount the amplifier

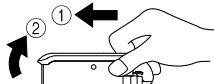
- Fit the rear part of the mounting section of the amplifier on a 35 mm 1.378 in width DIN rail.
- Press down the front part of the mounting section of the amplifier on the 35 mm 1.378 in width DIN rail.



#### How to remove the amplifier

- Push the amplifier forward.
- Lift up the front part of the amplifier to remove it.

Note: Take care that if the front part is lifted up without pushing the amplifier forward, the hook on the rear portion of the mounting section is likely to break.

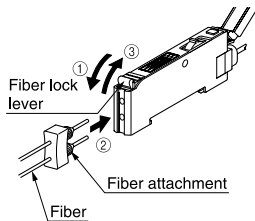


#### How to connect the fiber cables

- Make sure to fit the fiber attachment (FX-AT4), enclosed with the fiber, to the fibers. Please refer to the instruction manual of the fiber attachment for the fitting method.

- Snap the fiber lock lever down.
- Insert the fiber cables slowly into the inlets until they stop. (Note)
- Return the fiber lock lever to the original position, till it stops.

Note: In case the fiber cables are not inserted to a position where they stop, the sensing becomes unstable.

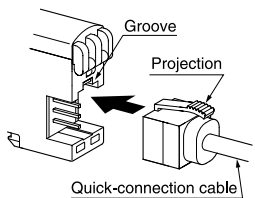


### Connection

- Make sure that the power supply is off while connecting or disconnecting the quick-connection cable.

#### Connection method

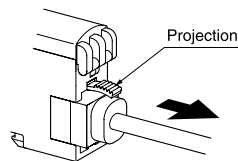
- Holding the connector of the quick-connection cable, align its projection with the groove at the top portion of the amplifier connector.
- Insert the connector till a click is felt.



#### Disconnection method

- Pressing the projection at the top of the quick-connection cable connector, pull out the connector.

Note: Take care that if the connector is pulled out without pressing the projection, the projection may break. Do not use a quick-connection cable whose projection has broken. Further, do not pull by holding the cable, as this can cause a cable-break.

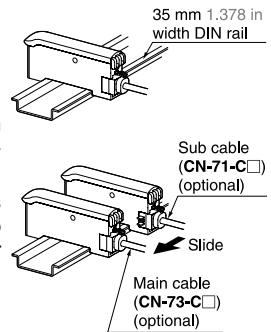


### Cascading amplifiers

- Make sure that the power supply is off while cascading or removing the amplifiers.
- Make sure to check the allowable ambient temperature, as it depends on the number of amplifiers connected in cascade.
- In case two, or more, amplifiers are connected in cascade, make sure to mount them on a DIN rail.
- When connecting in cascade, mount the amplifiers close to each other, fitting them between the optional end plates (MS-DIN-E) mounted at the two ends.
- When the amplifiers move on the DIN rail depending on the attaching condition, fitting them between the optional end plates (MS-DIN-E) mounted at the two ends.
- Up to maximum 15 amplifiers can be added (total 16 amplifiers connected in cascade.)
- When connecting more than two amplifiers in cascade, use the sub cable (CN-71-C□) as the quick-connection cable for the second amplifier onwards.
- Since the model setting gets changed if collective teaching is done for the amplifiers in Leak setting (F7 mode) and in Liquid setting (F9 mode) mounted in cascade, note that collective teaching should not be done for amplifiers with different model settings mounted in cascade.
- Since the communication function of this amplifier and that of the fiber sensor FX-301/311 series is different, if these models are mounted in cascade, do not use the communication function.
- In case of cascading, wait for 10 minutes, or more, to use the teaching function after the power is switched on.

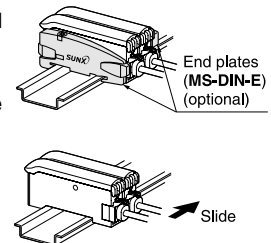
#### Cascading method

- Mount the amplifiers, one by one, on the 35 mm 1.378 in width DIN rail. (For details, refer to 'Mounting'.)
- Slide the sub units next to each other, and connect the quick-connection cables.
- Mount the optional end plates (MS-DIN-E) at both the ends to hold the amplifiers between their flat sides.
- Tighten the screws to fix the end plates (MS-DIN-E).



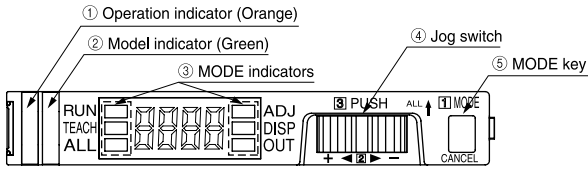
#### Dismantling method

- Loosen the screws of the end plates (MS-DIN-E).
- Remove the end plates (MS-DIN-E).
- Slide the sub units and remove them one by one. (For details, refer to 'Mounting'.)



## PRECAUTIONS FOR PROPER USE

### Part description



- ① Operation indicator (Orange)... Lights up when output is ON.
- ② Model indicator (Green)... Lights up during liquid setting (F9 mode).
- ③ MODE indicators...
  - RUN (Green): Lights up during normal sensing operation.
  - TEACH (Yellow): Lights up when the individual teaching mode is selected.
  - ALL (Yellow): Lights up when the collective teaching mode is selected.
  - ADJ (Yellow): Lights up when the threshold value fine adjustment mode is selected or the sensitivity switching function is activated.
  - DISP (Yellow): Lights up when the digital display setting mode is selected or the timer function is activated.
  - OUT (Yellow): Lights up when the forced output mode is selected or the NO / NC switching function is activated.
- ④ Jog switch... Moving this switch in the '+' or '-' direction, allows different items to be viewed for selection and pressing the switch then confirms the selected setting.
- ⑤ MODE key... This key is used to select operating modes and to cancel settings during the configuration process.

### Setting items

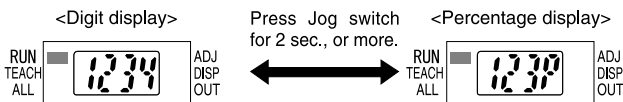
<b>RUN Run</b> Normal sensing condition	<b>TEACH Teaching</b> Mode for teaching with one unit	<b>ALL All</b> Mode for teaching 2 or more units collectively
<b>OUT Out</b> Mode for turning the forced output ON or OFF regardless of the incident light intensity NO and NC can be selected (F9 mode only)	<b>DISP Display</b> Mode for shifting the digital display and switching to ECO mode *Timer can be set (F9 mode only)	<b>ADJ Adjust</b> Fine-adjusts the threshold value Low, high, or automatic sensitivity can be selected

### RUN Mode

- When MODE indicator / RUN (green) lights up, the display setting or the sensitivity select setting can be checked. Refer to 'Sensitivity selection function' on p.605 for further details of sensitivity select setting.

#### How to change to 'percent display'

- When Jog switch is pressed for 2 sec., or more, the display changes as per the diagram below.



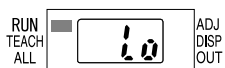
The incident light intensity is displayed within the range 0 to 4,000.

The incident light intensity is displayed in percentage (within 0 to 999) based on the threshold value as the reference.

#### How to check the sensitivity state

- If Jog switch is turned to '+' or '-' side, the present sensitivity state can be confirmed. After 2 sec., the display returns to 'digit display' or 'percent display'.

<LO mode>



or

<HI mode>



Operating in the low sensitivity mode.

Operating in the high sensitivity mode.

### Individual teaching mode

- The sensitivity selection function is set to the automatic sensitivity setting (Auto) at the time of factory shipment. In case sensitivity selection setting is done, make sure to carry out 'teaching' after the sensitivity selection setting. For the sensitivity selection setting, refer to 'Sensitivity selection function' on p.525.

- When MODE indicator / TEACH (yellow) lights up, threshold value can be set on a single unit.

Step	Description	Display
①	Insert Leak detection fiber (FD-F7□) or Liquid detection fiber (FT-F9□). Press MODE key to light up MODE indicator / TEACH (yellow).	1234
②	Turn the jog switch to '+' or '-' side to set to either Leak (F7) mode (·F7·) or Liquid (F9) mode (·F9·). In case Liquid (F9) mode (·F9·) is set, the model indicator (Green) lights up.	·F7· ·F9·
③	Press Jog switch in no-leak condition with Leak detection fiber (FD-F7□) or no-liquid condition with Liquid detection fiber (FT-F9□). Then, '!' on the display moves from left to right.	!
④	When teaching is accepted, the result of threshold value setting is displayed. • In case stable sensing is possible: 'Good' on the display blinks three times. • In case stable sensing is not possible: 'Err' on the display blinks. (Note 1)	Good Err
⑤	If the teaching result is 'Good', the sensor returns to RUN mode automatically and the incident light intensity is shown on the display. MODE indicator / RUN (green) lights up. The setting is complete.	1234

- Notes: 1) For details, refer to 'Error indication' on p.526.  
 2) The initial setting at the time of factory shipment is Liquid (F9) mode (·F9·).  
 3) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

# FX-301-F

## PRECAUTIONS FOR PROPER USE

### Collective teaching mode

- When MODE indicator / ALL (yellow) lights up, a threshold value can be collectively set to amplifiers mounted in cascade.

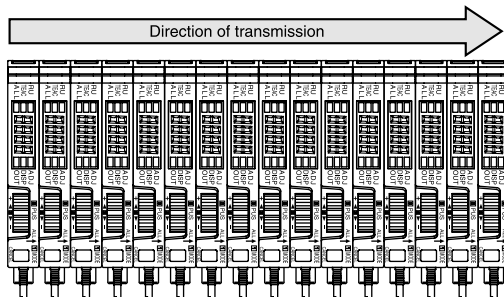
Step	Description	Display
①	Insert Leak detection fiber (FD-F7□) or Liquid detection fiber (FT-F9□). Press MODE key to light up MODE indicator / ALL (yellow).	1234
②	Turn the jog switch to '+' or '-' side to set to either Leak (F7) mode (·f·) or Liquid (F9) mode (·f9·). In case Liquid (F9) mode (·f9·) is set, the model indicator (green) lights up.	·f· ·f9·
③	Press Jog switch in no-leak condition with Leak detection fiber (FD-F7□) fitted or no-liquid condition with Liquid detection fiber fitted (FT-F9□). Then, '0' on the display moves from top left to top right and from bottom right to bottom left (twice).	0
④	When teaching is accepted, the result of threshold value setting is displayed. • In case stable sensing is possible: 'Good' on the display blinks three times. • In case stable sensing is not possible: 'Er·3' on the display blinks. (Note 1)	Good Er·3
⑤	If the teaching result is 'Good', the sensor returns to RUN mode automatically and the incident light intensity is shown on the display. MODE indicator / RUN (green) lights up. The setting is complete.	1234

- Notes: 1) For details, refer to 'Error indication' on p.526.  
2) In collective teaching, only an instruction of the teaching operation is transmitted, the threshold value is not copied. The threshold value taught at the respective amplifier is set.  
3) When the collective teaching is done, the setting conditions are copied. In case an individual setting condition is desired to be set, set it individually after the collective teaching.  
4) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

○: Copied ×: Not copied

Mode	Digit display Percent display	Model setting	Digital display setting	Sensitivity selection function	Timer function	NO / NC selection function
Leak (F7) mode	○	○	○	○	×	×
Liquid (F9) mode	○	○	○	○	○	○

- 5) The collective teaching transmits the information only in the direction of the arrow shown on the amplifier operation panel. The collective teaching is also possible from the middle of the amplifiers mounted in cascade. Check the direction of the transmission before collective teaching is done.



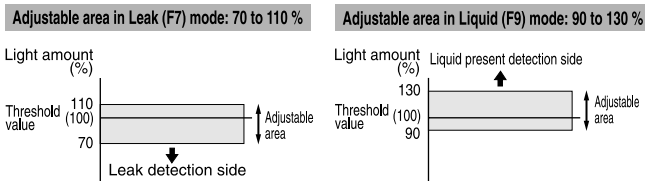
- 6) Since the model setting is also transmitted, do not carry out collective teaching when the amplifiers in Leak (F7) mode (·f·) and in Liquid (F9) mode (·f9·) are mixed in cascade connection.  
7) Do not move or bend the fiber cable after the sensitivity setting. Detection may become unstable.

### Threshold value fine adjustment mode

- When MODE indicator / ADJ (yellow) lights up, the set threshold value can be fine adjusted.

Step	Description	Display
①	Press MODE key to light up MODE indicator / ADJ (yellow).	1234
②	Turn Jog switch to the '+' side, to increase the threshold value. Turn Jog switch to the '-' side, to decrease the threshold value.	1235
③	When Jog switch is pressed, the changed threshold value blinks 3 times and is confirmed.	1235
④	When MODE key is pressed 3 times, or for 2 sec., or more, the sensor returns to the RUN mode and the incident light intensity is shown in the display. MODE indicator / RUN (green) lights up. The setting is complete.	1234

Note: The adjustable area is limited as shown below. In order to adjust the threshold the outside the adjustable area, confirm it within the area once and then adjust it again.



### Digital display setting mode

- When MODE indicator / DISP (yellow) lights up, the digital display can be switched to the light-up mode, the eco mode or the inverse mode.

Step	Description	Display
①	Press MODE key to light up MODE indicator / DISP (yellow).	EcOf
②	When Jog switch is turned to the '+' side or '-' side, the mode in the digital display changes. EcOf: This is the light-up mode in the digital display. The digital display always lights up. EcOn: This is the eco mode. After confirmation, if key operation has not been done for 8 sec., or more, 'EcO' flashes, and then the digital display is turned off. When a key operation is done after the display is turned off or when the collective teaching is carried out, the digital display lights up. EwOn: This is the inverse mode of the digital display. In the normal display condition, the display changes to the inverse display and in the inverse condition, the display changes to the normal display.	EcOf EcOn EwOn
③	When Jog switch is pressed, the set display blinks 3 times and is confirmed.	EcOn
④	When MODE key is pressed twice or for 1 sec., or more, the sensor returns to RUN mode and the incident light intensity is displayed. • MODE indicator / RUN (green) lights up. • The setting is complete.	1234

Note: The initial setting at the time of factory shipment is the light-up mode ( EcOf ).

## PRECAUTIONS FOR PROPER USE

### Forced output mode

- When MODE indicator / OUT (yellow) lights up, the output can be compulsory changed to ON or OFF regardless of the incident light intensity.

Step	Description	Display
①	Press MODE key to light up MODE indicator / OUT (yellow). (Present output state is displayed.)	
②	When Jog switch is turned to the '+' side or '-' side, the output is compulsory changed to ON or OFF. Since the emitting element of the amplifier blinks, it is possible to check the fiber connected to the amplifier. When the output is compulsory changed to ON, the operation indicator (orange) lights up.	
③	Press MODE key to return the sensor to step ①.	
④	When MODE key is pressed, the sensor returns to RUN mode and the incident light intensity is displayed. MODE indicator / RUN (green) lights up. The setting is complete.	

### Sensitivity selection function

- If Jog switch is pressed for 3 sec., or more, when MODE indicator / ADJ (yellow) lights up, the sensitivity can be fixed to low sensitivity or high sensitivity, or set to automatic sensitivity.

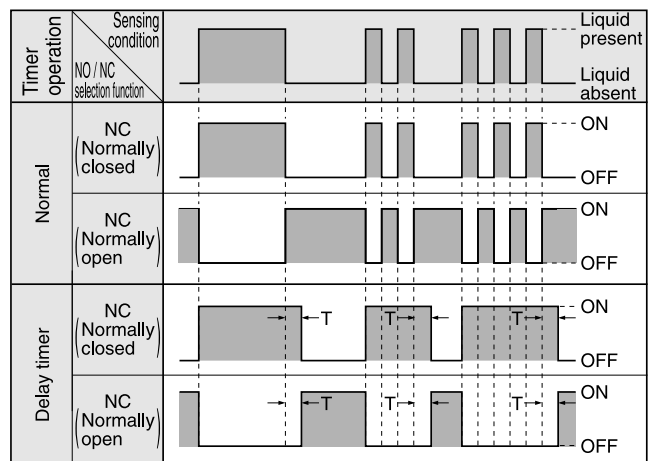
Step	Description	Display
①	Press MODE key to light up MODE indicator / ADJ (yellow).	
②	Press Jog switch for 3 sec. or more. (The sensor goes into the sensitivity setting condition.) MODE indicator / RUN (green) blinks.	
③	When Jog switch is turned to the '+' side or '-' side, the display and MODE indicator / RUN (green) blinks, and the sensitivity can be selected. $Auto$ : Automatic sensitivity setting After selecting the automatic sensitivity, the optimum sensitivity is set by carrying out teaching. $Lo$ : Low sensitivity setting $Hi$ : High sensitivity setting	  
④	When Jog switch is pressed, the setting display blinks 3 times and is confirmed.	
⑤	MODE indicator / TEACH (green) lights up and '·f·' or '·f·' is displayed. After sensitivity selection, carry out the teaching. For the setting method of teaching, refer to 'Individual teaching mode' on p.603.	 

Note: The initial setting at the time of factory shipment is the automatic sensitivity setting (  $Auto$  ).

### Timer function [Liquid (F9) mode only]

- The timer setting can be done by pressing the jog switch for 3 sec., or more, when Liquid (F9) mode ( ·f· ) has been set and MODE indicator / DISP (yellow) lights up. In case of Leak (F7) mode ( ·f· ), the display does not change to the timer function. For the selection method of Leak (F7) mode / Liquid (F9) mode, refer to 'Individual teaching mode' on p.523 or 'Collective teaching mode' on p.524.
- This product incorporates a delay timer which reduces the effect of air bubbles, etc.

#### Time chart



Timer period: T = 10 ms, 100 ms, 1,000 ms

Step	Description	Display
①	Confirm if the sensor is in Liquid (F9) mode ( ·f· ) in 'Individual teaching mode' or 'Collective teaching mode'.	
②	Press MODE key to light up MODE indicator / DISP (yellow).	
③	Press Jog switch for 3 sec., or more. (The sensor goes into the timer setting condition.) MODE indicator / RUN (green) blinks.	
④	When Jog switch is turned to the '+' side or '-' side, the display and MODE indicator / RUN (green) blinks, and the timer period can be chosen. $n0n$ : Without timer $n10$ : 10 ms timer $n100$ : 100 ms timer $n1000$ : 1,000 ms timer	   
⑤	When Jog switch is pressed, setting display blinks 3 times and is confirmed.	
⑥	The sensor returns to step ②.	
⑦	When MODE key is pressed twice or for 1 sec., or more, the sensor returns to RUN mode and the incident light intensity is displayed. MODE indicator / RUN (green) lights up. The setting is complete.	

Note: The initial setting at the time of factory shipment is the without timer (  $n0n$  ) condition.

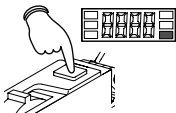

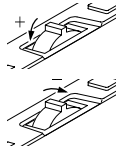
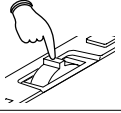
# FX-301-F

## PRECAUTIONS FOR PROPER USE

### NO / NC selection function [Liquid (F9) mode only]

- The NO / NC selection can be done by pressing the jog switch for 3 sec., or more, when Liquid (F9) mode (  $\cdot f_9 \cdot$  ) has been set and MODE indicator / DISP (yellow) lights up. In case of Leak (F7) mode (  $\cdot f_7 \cdot$  ), the display does not change to NO / NC selection function.

For the selection method of Leak (F7) mode / Liquid (F9) mode, refer to 'Individual teaching mode' on p.603 or 'Collective teaching mode' on p.604.

Step	Description	Display
①	Confirm if the sensor is in Liquid (F9) mode ( $\cdot f_9 \cdot$ ) in 'Individual teaching mode' or 'Collective teaching mode'.	$\cdot f_9 \cdot$
②	Press MODE key to light up MODE indicator / OUT (yellow). 	$o_n$
③	Press Jog switch for 3 sec., or more. (The sensor goes into the NO / NC setting condition. MODE indicator / RUN (green) blinks. 	$n_c$
④	When Jog switch is turned to the '+' side or '-' side, the display and MODE indicator / RUN (green) blinks, and NO / NC can be chosen. $n_c$ : Normally closed (OFF in liquid absent condition.) $n_o$ : Normally open (OFF in liquid present condition.) 	$n_c$ $n_o$
⑤	When Jog switch is pressed, setting display blinks 3 times and is confirmed. 	$n_o$
⑥	The sensor returns to the step ②.	$o_n$
⑦	When MODE key is pressed, the sensor returns to RUN mode and the incident light intensity is displayed. MODE indicator / RUN (green) lights up. The setting is complete.	1234

Note: The initial setting at the time of factory shipment is the normal close (  $n_c$  ) setting.

### Error indication

- When an error is displayed, remedy as follows.

Error indication	Cause	Remedy
$E_r \cdot 1$	Excessive current flows due to a short-circuit.	Switch off the power supply and check the load.
$E_r \cdot 3$	The teaching is abnormal.	Check the installation condition of the fiber, or whether the fiber has come out, and then do teaching again. Press MODE key to cancel ' $E_r \cdot 3$ '. After the cancellation, the sensor operates at the set value conditions before the error. However, in case the sensitivity selection function has been set to the automatic sensitivity setting ( $n_{opt}$ ), the sensor operates at optimum sensitivity.
$E_r \cdot 5$	The communication is abnormal.	Check if the amplifiers mounted in cascade are disconnected. After the confirmation, do the teaching again.

### Wiring

- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- Make sure to use an isolation transformer for the DC power supply. If an auto-transformer (single winding transformer) is used, this product or the power supply may get damaged.
- In case a surge is generated in the used power supply, connect a surge absorber to the supply and absorb the surge.
- Take care that short-circuit or wrong wiring of the load may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Make sure to use the optional quick-connection cable for the connection of the amplifier. Extension up to total 100 m 328.084 ft is possible with 0.3 mm<sup>2</sup>, or more, cable. However, in order to reduce noise, make the wiring as short as possible.

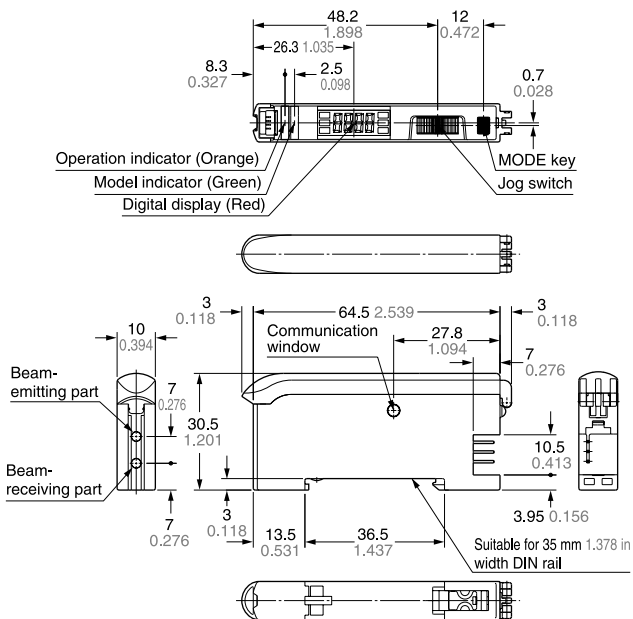
### Others

- Do not use during the initial transient time (0.5 sec. approx.) after the power supply is switched on.
- Take care that the sensor is not directly exposed to fluorescent light from a rapid-starter lamp or a high frequency lighting device, as it may affect the sensing performance.
- Avoid dust, dirt, and steam.
- When the fiber head gets dusty or dirty etc. the sensitivity deteriorates. To keep stable detection, wipe the fiber head to remove dust or dirt etc. and carry out sensitivity teaching periodically.
- This sensor is suitable for indoor use only.
- Take care that the product does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- This sensor cannot be used in an environment containing inflammable or explosive gases.
- Never disassemble or modify the sensor.

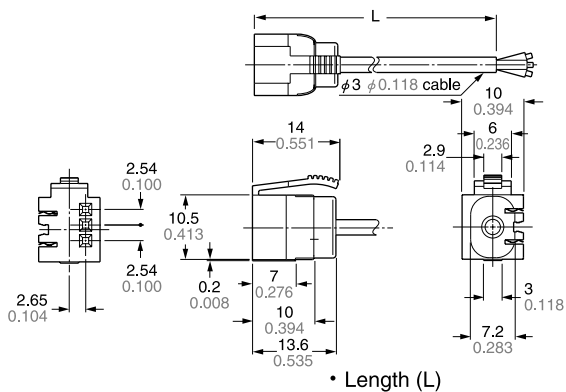
# FX-301-F

## DIMENSIONS (Unit: mm in)

### FX-301-F FX-301P-F Amplifier



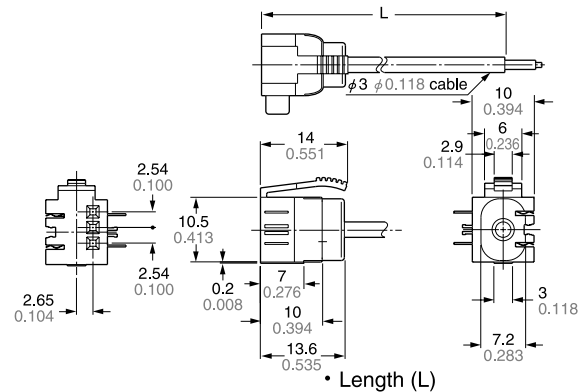
### CN-73-C1 CN-73-C2 CN-73-C5 Main cable (Optional)



• Length (L)

Model No.	Length (mm in)
<b>CN-73-C1</b>	1,000 39.390
<b>CN-73-C2</b>	2,000 78.740
<b>CN-73-C5</b>	5,000 196.850

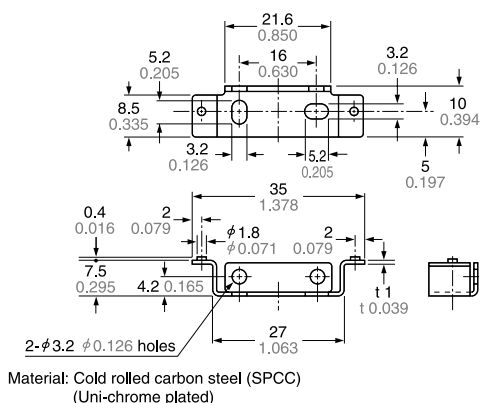
### CN-71-C1 CN-71-C2 CN-71-C5 Sub cable (Optional)



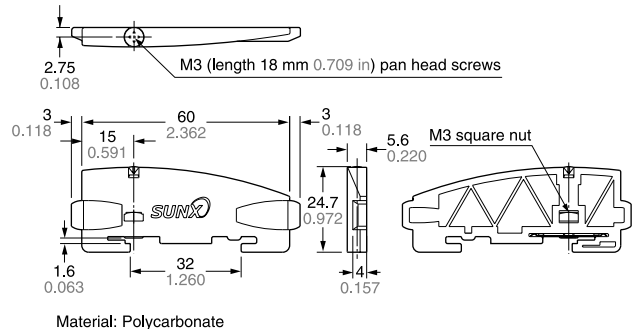
• Length (L)

Model No.	Length (mm in)
<b>CN-71-C1</b>	1,000 39.390
<b>CN-71-C2</b>	2,000 78.740
<b>CN-71-C5</b>	5,000 196.850

### MS-DIN-2 Amplifier mounting bracket (Optional)



### MS-DIN-E End plates (Optional)



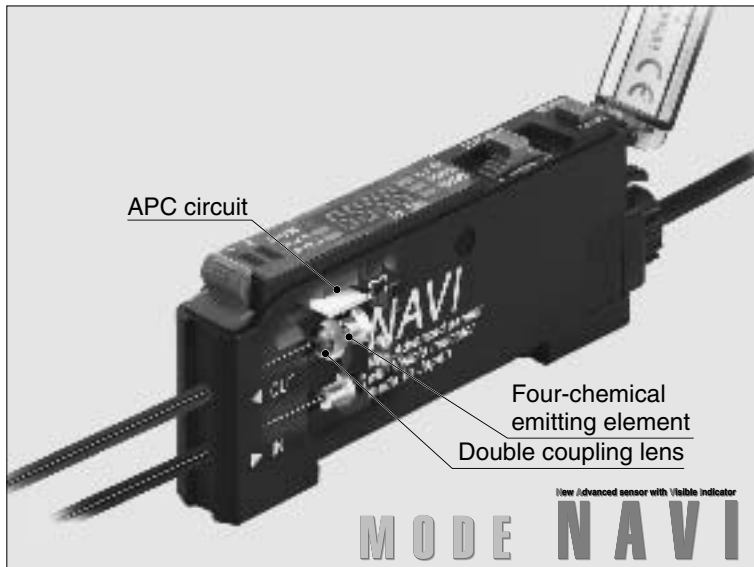


# FX-305

## Digital Fiber Sensor

SERIES

**New**

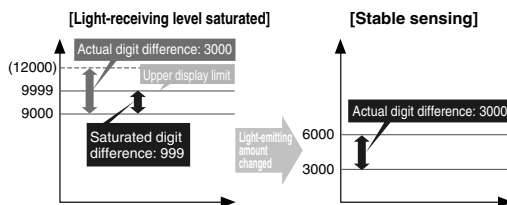


### Digital Fiber Sensor with 2 independent outputs



### Industry first! Light-emitting amount selection function

If the light-receiving level becomes saturated during close-range sensing or when sensing transparent or ultra-small objects, you can adjust the light-emitting amount of the sensor to stabilize sensing without needing to change the response time. Sensing that previously required the response time or fibers to be changed can now be set much more easily using this function.



#### Comparison of saturation remedies

[Conventional models]	[FX-305]
Response time: Mode selection → Affects positioning precision	<b>Variable light amount function</b> Makes steps such as those at left unnecessary.
Changing fiber: Change to thinner fiber to reduce light amount → Man-hour and cost inefficiencies	
Changing setting position: Increase sensing range → Space and man-hour inefficiencies	

### High-speed response 65µs

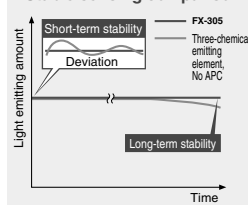


High-speed response that is about twice as fast as before has been achieved. Even small objects moving at high speeds can be sensed. In addition, interference between two units is prevented in high-speed mode (H-SP).

### Stable sensing over long and short periods

In addition to a 'four-chemical emitting element' which suppresses changes in the light-emitting element over time so that a stable level of light emission can be maintained over long periods, a new 'Auto Power Control (APC) circuit' has also been adopted. Because fluctuations over short periods of time have also been suppressed, stable sensing is possible very quickly once the power is turned back on after setup changes.

#### Stable sensing comparison



### Industry's largest display 9999

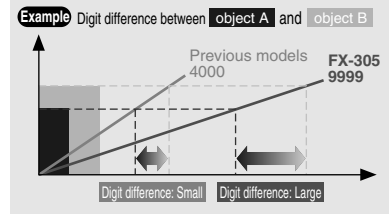


Industry's largest display with 4 digits (9999). With a greater difference in digit value than previous models, threshold values can be set in units of 1 digit up to maximum 9999. Threshold setting can now be done more easily and accurately.

#### Digit difference comparison

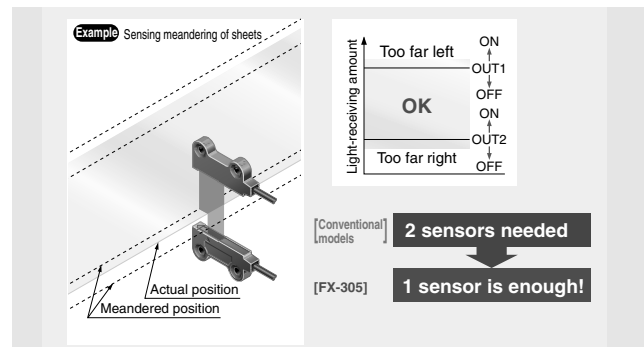


(During STDF, LONG and U-LG modes)



### Independent dual outputs

Two independent output channels are provided, so that one sensor can be used for control tasks that previously required two sensors. In addition, the second output channel can be used for simple self-diagnosis and alarm output, so that ease of maintenance is improved.



### Largest number in the industry! Automatic interference prevention of up to 16 units

Can be used even in places where fibers need to be installed close together.

## SPECIFICATIONS

Item	Type	NPN output	PNP output
	Model No.	FX-305	FX-305P
Sensing range (mm)		Thru-beam type (FT-B8): 1,700 (U-LG), 1,100 (LONG), 730 (STDF) 530 (STD), 400 (FAST), 200 (H-SP) Reflective type (FD-B8): 600 (U-LG), 480 (LONG), 280 (STDF) 220 (STD), 160 (FAST), 85 (H-SP)	
Supply voltage		12 to 24 V DC $\pm$ 10 % Ripple P-P 10 % or less	
Power consumption		Normal operation: 960 mW or less (Current consumption 40 mA or less at 24 V supply voltage) ECO mode: 600 mW or less (Current consumption 25 mA or less at 24 V supply voltage)	
Output (Output 1, Output 2)		NPN open-collector transistor • Maximum sink current: each 50 mA (Note 1) • Applied voltage: 30 V DC or less (between output and 0 V) • Residual voltage: 1.5 V or less [at each 50 mA (Note 1) sink current]	PNP open-collector transistor • Maximum source current: each 50 mA (Note 1) • Applied voltage: 30 V DC or less (between output and +V) • Residual voltage: 1.5 V or less [at each 50 mA (Note 1) source current]
	Output operation	Selectable either Light-ON or Dark-ON, with jog switch	
Short-circuit protection		Incorporated	
Response time (Note 2)		H-SP: 65 $\mu$ s or less, FAST 150 $\mu$ s or less, STD: 250 $\mu$ s or less, STDF: 700 $\mu$ s or less, LONG: 2.5 ms or less, U-LG: 4.5 ms or less selectable with jog switch	
Digital display		4-digit red LED display	
Sensitivity setting		Normal mode: 2-level teaching / Limit teaching / Full-auto teaching / Max. sensitivity teaching / Manual adjustment Window comparator mode: Teaching (1-level / 2-level / 3-level) / Manual adjustment	
Fine sensitivity adjustment function		Incorporated	
Timer function		Incorporated with variable ON-delay / OFF-delay / ONE-SHOT / ON-delay-OFF-delay / ON-delay-ONE-SHOT timer, switchable either effective or ineffective (Timer period Output 1: 0.5 ms, 1 to 9999 ms, Output 2: 0.5 ms, 1 to 500 ms)	
Automatic interference prevention function (Note 2) (Note 3)		Incorporated [Up to 4 sets of fiber heads can be mounted close together (However, U-LG mode is 8 sets, H-SP mode is 2 sets.)]	
Ambient temperature		-10 to +55 °C +14 to +131 °F (If 4 to 7 units are connected in cascade: -10 to +50 °C +14 to +122 °F, if 8 to 16 units are connected in cascade: -10 to +45 °C +14 to +113 °F) (No dew condensation or icing allowed), Storage: -20 to +70 °C -4 to +158 °F	
Ambient humidity		35 to 85 % RH, Storage: 35 to 85 % RH	
Emitting element		Red LED (modulated)	
Material		Enclosure: Heat-resistant ABS, Transparent cover: Polycarbonate Press switches: Acrylic, Jog switch: Heat-resistant ABS	
Connecting method		Connector (Note 4)	
Cable extension		Extension up to total 100 m 328.084 ft is possible with 0.3 mm <sup>2</sup> , or more, cable.	
Weight		20 g approx.	

Notes: 1) 50 mA per output. 25 mA if five, or more, amplifiers are connected in cascade.

- When the interference prevention function 'IP-2' is set, the number of mountable fibers becomes double. Furthermore, take care that the response time also becomes double.
- When the power supply is switched on, the light emission timing is automatically set for interference prevention.
- The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cables given below.  
Main cable (4-core): CN-74-C1 (cable length 1 m 3.281 ft), CN-74-C2 (cable length 2 m 6.562 ft)  
CN-74-C5 (cable length 5 m 16.404 ft)  
Sub cable (2-core): CN-72-C1 (cable length 1 m 3.281 ft), CN-72-C2 (cable length 2 m 6.562 ft)  
CN-72-C5 (cable length 5 m 16.404 ft)  
CN-73-C□ and CN-71-C□ cannot be used.

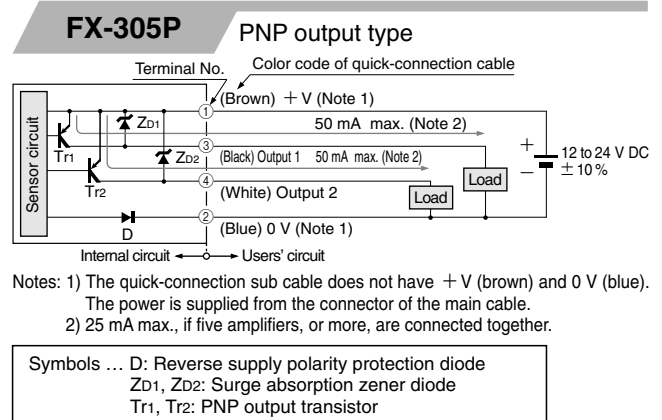
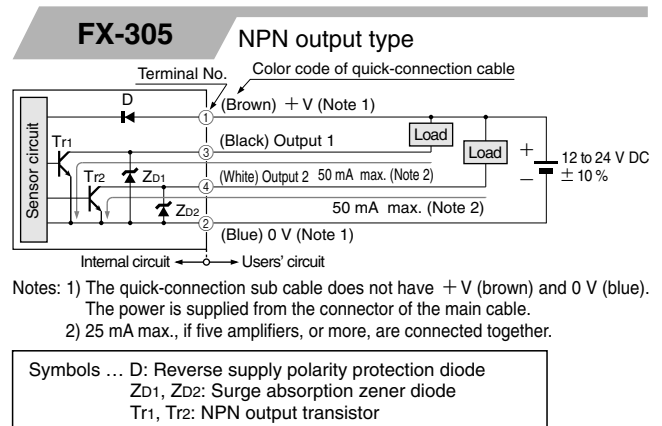
## PRECAUTIONS FOR PROPER USE



This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.

All information is subject to change without prior notice.

## I/O CIRCUIT



## DIMENSIONS (Unit: mm in)

